10/571085

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RADIAL EXPANSION SYSTEM

Cross Reference To Related Applications

[001] This application is the U.S. National Stage application for PCT application serial no. PCT/US2004/028831, attorney docket no. 25791.308.02, filed on 9/7/2004, which claimed the benefit of the filing dates of the following: (1) U.S. provisional patent application serial number 60/500435, attorney docket number 25791.304, filed on 9/05/2003, (2) U.S. provisional patent application serial number 60/585,370, attorney docket number 25791.299, filed on 7/2/2004; and (3) U.S. provisional patent application serial number 60/600679, attorney docket number 25791.194, filed on 8/11/2004, the disclosures of which are incorporated herein by reference.

[002] This application is a continuation-in-part of one or more of the following: (1) PCT application US02/04353, filed on 2/14/02, attorney docket no. 25791.50.02, which claims priority from U.S. provisional patent application serial no. 60/270,007, attorney docket no. 25791.50, filed on 2/20/2001; (2) PCT application US 03/00609, filed on 1/9/03, attorney docket no. 25791.71.02, which claims priority from U.S. provisional patent application serial no. 60/357,372 , attorney docket no. 25791.71, filed on 2/15/02; (3) U.S. provisional patent application serial number 60/585,370, attorney docket number 25791.299, filed on 7/2/2004; and (4) U.S. provisional patent application serial number 60/600679, attorney docket number 25791.194, filed on 8/11/2004, the disclosures of which are incorporated herein by reference.

[003] The application is a continuation-in-part of U.S. utility patent application serial no. 10/528498, attorney docket no. 25791.118.08, filed on 3/18/05, which was the National Stage for PCT application serial no. PCT/US03/025667, attorney docket no. 25791.118.02, filed on 8/18/03, which claimed the benefit of the filing date of U.S. provisional patent application serial no. 60/412653, attorney docket 25791.118, filed on 9/20/2002, the disclosures of which are incorporated herein by reference.

[004] This application is related to the following co-pending applications: (1) U.S. National State patent application serial no. _________, attorney docket no. 25791.305.05, filed on ___________; (2) U.S. National State patent application serial no. _________, attorney docket no. 25791.306.04, filed on ___________; (3) U.S. National State patent application serial no. _________, attorney docket no. 25791.307.04, filed on ___________; and (4) U.S. National State patent application serial no. _________, attorney docket no. 25791.307.04, filed on ___________, the disclosures of which are incorporated herein by reference.

[005] This application is related to the following co-pending applications: (1) U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (2) U.S. patent application serial no. 09/510,913,

attorney docket no. 25791.7.02, filed on 2/23/2000, which claims priority from provisional application 60/121,702, filed on 2/25/99, (3) U.S. patent application serial no. 09/502,350, attorney docket no. 25791.8.02, filed on 2/10/2000, which claims priority from provisional application 60/119,611, filed on 2/11/99, (4) U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (5) U.S. patent application serial no. 10/169,434, attorney docket no. 25791.10.04, filed on 7/1/02, which claims priority from provisional application 60/183,546, filed on 2/18/00, (6) U.S. patent no. 6,640,903 which was filed as U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (7) U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (8) U.S. patent number 6,575,240, which was filed as patent application serial no. 09/511,941, attorney docket no. 25791.16.02, filed on 2/24/2000, which claims priority from provisional application 60/121,907, filed on 2/26/99, (9) U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (10) U.S. patent application serial no. 09/981,916, attorney docket no. 25791.18, filed on 10/18/01 as a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (11) U.S. patent number 6,604,763, which was filed as application serial no. 09/559,122, attorney docket no. 25791.23.02, filed on 4/26/2000, which claims priority from provisional application 60/131,106, filed on 4/26/99, (12) U.S. patent application serial no. 10/030,593, attorney docket no. 25791.25.08, filed on 1/8/02, which claims priority from provisional application 60/146,203, filed on 7/29/99, (13) U.S. provisional patent application serial no. 60/143,039, attorney docket no. 25791.26, filed on 7/9/99, (14) U.S. patent application serial no. 10/111,982, attorney docket no. 25791.27.08, filed on 4/30/02, which claims priority from provisional patent application serial no. 60/162,671, attorney docket no. 25791.27, filed on 11/1/1999, (15) U.S. provisional patent application serial no. 60/154,047, attorney docket no. 25791.29, filed on 9/16/1999, (16) U.S. provisional patent application serial no. 60/438,828, attorney docket no. 25791.31, filed on 1/9/03, (17) U.S. patent number 6,564,875, which was filed as application serial no. 09/679,907, attorney docket no. 25791.34.02, on 10/5/00, which claims priority from provisional patent application serial no. 60/159,082, attorney docket no. 25791.34, filed on 10/12/1999, (18) U.S. patent application serial no. 10/089,419, filed on 3/27/02, attorney docket no. 25791.36.03, which claims

priority from provisional patent application serial no. 60/159,039, attorney docket no. 25791.36, filed on 10/12/1999, (19) U.S. patent application serial no. 09/679,906, filed on 10/5/00, attorney docket no. 25791.37.02, which claims priority from provisional patent application serial no. 60/159,033, attorney docket no. 25791.37, filed on 10/12/1999, (20) U.S. patent application serial no. 10/303,992, filed on 11/22/02, attorney docket no. 25791.38.07, which claims priority from provisional patent application serial no. 60/212,359, attorney docket no. 25791.38, filed on 6/19/2000, (21) U.S. provisional patent application serial no. 60/165,228, attorney docket no. 25791.39, filed on 11/12/1999, (22) U.S. provisional patent application serial no. 60/455,051, attorney docket no. 25791.40, filed on 3/14/03, (23) PCT application US02/2477, filed on 6/26/02, attorney docket no. 25791.44.02, which claims priority from U.S. provisional patent application serial no. 60/303,711, attorney docket no. 25791.44, filed on 7/6/01, (24) U.S. patent application serial no. 10/311,412, filed on 12/12/02, attorney docket no. 25791.45.07, which claims priority from provisional patent application serial no. 60/221,443, attorney docket no. 25791.45, filed on 7/28/2000, (25) U.S. patent application serial no. 10/, filed on 12/18/02, attorney docket no. 25791.46.07, which claims priority from provisional patent application serial no. 60/221,645, attorney docket no. 25791.46, filed on 7/28/2000, (26) U.S. patent application serial no. 10/322,947, filed on 1/22/03, attorney docket no. 25791.47.03, which claims priority from provisional patent application serial no. 60/233,638, attorney docket no. 25791.47, filed on 9/18/2000, (27) U.S. patent application serial no. 10/406,648, filed on 3/31/03, attorney docket no. 25791.48.06, which claims priority from provisional patent application serial no. 60/237,334, attorney docket no. 25791.48, filed on 10/2/2000, (28) PCT application US02/04353, filed on 2/14/02, attorney docket no. 25791.50.02, which claims priority from U.S. provisional patent application serial no. 60/270,007, attorney docket no. 25791.50, filed on 2/20/2001, (29) U.S. patent application serial no. 10/465,835, filed on 6/13/03, attorney docket no. 25791.51.06, which claims priority from provisional patent application serial no. 60/262,434, attorney docket no. 25791.51, filed on 1/17/2001, (30) U.S. patent application serial no. 10/465,831, filed on 6/13/03, attorney docket no. 25791.52.06, which claims priority from U.S. provisional patent application serial no. 60/259,486, attorney docket no. 25791.52, filed on 1/3/2001, (31) U.S. provisional patent application serial no. 60/452,303, filed on 3/5/03, attorney docket no. 25791.53, (32) U.S. patent number 6,470,966, which was filed as patent application serial number 09/850,093, filed on 5/7/01, attorney docket no. 25791.55, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (33) U.S. patent number 6,561,227, which was filed as patent application serial number 09/852,026 , filed on 5/9/01, attorney docket no. 25791.56, as a divisional application of U.S. Patent Number

6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (34) U.S. patent application serial number 09/852,027, filed on 5/9/01, attorney docket no. 25791.57, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (35) PCT Application US02/25608, attorney docket no. 25791.58.02, filed on 8/13/02, which claims priority from provisional application 60/318,021, filed on 9/7/01, attorney docket no. 25791.58, (36) PCT Application US02/24399, attorney docket no. 25791.59.02, filed on 8/1/02, which claims priority from U.S. provisional patent application serial no. 60/313,453, attorney docket no. 25791.59, filed on 8/20/2001, (37) PCT Application US02/29856, attorney docket no. 25791.60.02, filed on 9/19/02, which claims priority from U.S. provisional patent application serial no. 60/326,886, attorney docket no. 25791.60, filed on 10/3/2001, (38) PCT Application US02/20256, attorney docket no. 25791.61.02, filed on 6/26/02, which claims priority from U.S. provisional patent application serial no. 60/303,740, attorney docket no. 25791.61, filed on 7/6/2001, (39) U.S. patent application serial no. 09/962,469, filed on 9/25/01, attorney docket no. 25791.62, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (40) U.S. patent application serial no. 09/962,470, filed on 9/25/01, attorney docket no. 25791.63, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (41) U.S. patent application serial no. 09/962,471, filed on 9/25/01, attorney docket no. 25791.64, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (42) U.S. patent application serial no. 09/962,467, filed on 9/25/01, attorney docket no. 25791.65, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (43) U.S. patent application serial no. 09/962,468, filed on 9/25/01, attorney docket no. 25791.66, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (44) PCT application US 02/25727, filed on 8/14/02, attorney docket no. 25791.67.03, which claims priority from U.S. provisional

patent application serial no. 60/317,985, attorney docket no. 25791.67, filed on 9/6/2001, and U.S. provisional patent application serial no. 60/318,386, attorney docket no. 25791.67.02, filed on 9/10/2001, (45) PCT application US 02/39425, filed on 12/10/02, attorney docket no. 25791.68.02, which claims priority from U.S. provisional patent application serial no. 60/343,674 , attorney docket no. 25791.68, filed on 12/27/2001, (46) U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, (now U.S. Patent 6,634,431 which issued 10/21/2003), which is a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (47) U.S. utility patent application serial no. 10/516,467, attorney docket no. 25791.70, filed on 12/10/01, which is a continuation application of U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, (now U.S. Patent 6,634,431 which issued 10/21/2003), which is a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (48) PCT application US 03/00609, filed on 1/9/03, attorney docket no. 25791.71.02, which claims priority from U.S. provisional patent application serial no. 60/357,372 , attorney docket no. 25791.71, filed on 2/15/02, (49) U.S. patent application serial no. 10/074,703, attorney docket no. 25791.74, filed on 2/12/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (50) U.S. patent application serial no. 10/074,244, attorney docket no. 25791.75, filed on 2/12/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (51) U.S. patent application serial no. 10/076,660, attorney docket no. 25791.76, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (52) U.S. patent application serial no. 10/076,661, attorney docket no. 25791.77, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (53) U.S. patent application serial no. 10/076,659, attorney docket no. 25791.78, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no.

25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (54) U.S. patent application serial no. 10/078,928, attorney docket no. 25791.79, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (55) U.S. patent application serial no. 10/078,922, attorney docket no. 25791.80, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (56) U.S. patent application serial no. 10/078,921, attorney docket no. 25791.81, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (57) U.S. patent application serial no. 10/261,928, attorney docket no. 25791.82, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (58) U.S. patent application serial no. 10/079,276, attorney docket no. 25791.83, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (59) U.S. patent application serial no. 10/262,009, attorney docket no. 25791.84, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (60) U.S. patent application serial no. 10/092,481, attorney docket no. 25791.85, filed on 3/7/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (61) U.S. patent application serial no. 10/261,926, attorney docket no. 25791.86, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (62) PCT application US 02/36157, filed on 11/12/02, attorney docket no. 25791.87.02, which claims priority from U.S. provisional patent application serial no. 60/338,996, attorney docket no. 25791.87, filed on 11/12/01, (63) PCT application US 02/36267, filed on 11/12/02, attorney docket no. 25791.88.02, which claims priority from U.S. provisional patent application serial no. 60/339,013, attorney docket no.

25791.88, filed on 11/12/01, (64) PCT application US 03/11765, filed on 4/16/03, attorney docket no. 25791.89.02, which claims priority from U.S. provisional patent application serial no. 60/383,917, attorney docket no. 25791.89, filed on 5/29/02, (65) PCT application US 03/15020, filed on 5/12/03, attorney docket no. 25791.90.02, which claims priority from U.S. provisional patent application serial no. 60/391,703, attorney docket no. 25791.90, filed on 6/26/02, (66) PCT application US 02/39418, filed on 12/10/02, attorney docket no. 25791.92.02, which claims priority from U.S. provisional patent application serial no. 60/346,309, attorney docket no. 25791.92, filed on 1/7/02, (67) PCT application US 03/06544, filed on 3/4/03, attorney docket no. 25791.93.02, which claims priority from U.S. provisional patent application serial no. 60/372,048, attorney docket no. 25791.93, filed on 4/12/02, (68) U.S. patent application serial no. 10/331,718, attorney docket no. 25791.94, filed on 12/30/02, which is a divisional U.S. patent application serial no. 09/679,906, filed on 10/5/00, attorney docket no. 25791.37.02, which claims priority from provisional patent application serial no. 60/159,033, attorney docket no. 25791.37, filed on 10/12/1999, (69) PCT application US 03/04837, filed on 2/29/03, attorney docket no. 25791.95.02, which claims priority from U.S. provisional patent application serial no. 60/363,829, attorney docket no. 25791.95, filed on 3/13/02, (70) U.S. patent application serial no. 10/261,927, attorney docket no. 25791.97, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (71) U.S. patent application serial no. 10/262,008, attorney docket no. 25791.98, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (72) U.S. patent application serial no. 10/261,925, attorney docket no. 25791.99, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (73) U.S. patent application serial no. 10/199,524, attorney docket no. 25791.100, filed on 7/19/02, which is a continuation of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (74) PCT application US 03/10144, filed on 3/28/03, attorney docket no. 25791.101.02, which claims priority from U.S. provisional patent application serial no. 60/372,632, attorney docket no. 25791.101, filed on 4/15/02, (75) U.S. provisional patent application serial no. 60/412,542, attorney docket no. 25791.102, filed on 9/20/02, (76) PCT application US 03/14153, filed on 5/6/03, attorney docket no. 25791.104.02, which claims priority from U.S. provisional patent

application serial no. 60/380,147, attorney docket no. 25791.104, filed on 5/6/02, (77) PCT application US 03/19993, filed on 6/24/03, attorney docket no. 25791.106.02, which claims priority from U.S. provisional patent application serial no. 60/397,284, attorney docket no. 25791.106, filed on 7/19/02, (78) PCT application US 03/13787, filed on 5/5/03, attorney docket no. 25791.107.02, which claims priority from U.S. provisional patent application serial no. 60/387,486, attorney docket no. 25791.107, filed on 6/10/02, (79) PCT application US 03/18530, filed on 6/11/03, attorney docket no. 25791.108.02, which claims priority from U.S. provisional patent application serial no. 60/387,961, attorney docket no. 25791.108, filed on 6/12/02, (80) PCT application US 03/20694, filed on 7/1/03, attorney docket no. 25791.110.02, which claims priority from U.S. provisional patent application serial no. 60/398,061, attorney docket no. 25791.110, filed on 7/24/02, (81) PCT application US 03/20870, filed on 7/2/03, attorney docket no. 25791.111.02, which claims priority from U.S. provisional patent application serial no. 60/399,240, attorney docket no. 25791.111, filed on 7/29/02, (82) U.S. provisional patent application serial no. 60/412,487, attorney docket no. 25791.112, filed on 9/20/02, (83) U.S. provisional patent application serial no. 60/412,488, attorney docket no. 25791.114, filed on 9/20/02, (84) U.S. patent application serial no. 10/280,356, attorney docket no. 25791.115, filed on 10/25/02, which is a continuation of U.S. patent number 6,470,966, which was filed as patent application serial number 09/850,093, filed on 5/7/01, attorney docket no. 25791.55, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (85) U.S. provisional patent application serial no. 60/412,177, attorney docket no. 25791.117, filed on 9/20/02, (86) U.S. provisional patent application serial no. 60/412,653, attorney docket no. 25791.118, filed on 9/20/02, (87) U.S. provisional patent application serial no. 60/405,610, attorney docket no. 25791.119, filed on 8/23/02, (88) U.S. provisional patent application serial no. 60/405,394, attorney docket no. 25791.120, filed on 8/23/02, (89) U.S. provisional patent application serial no. 60/412,544, attorney docket no. 25791.121, filed on 9/20/02, (90) PCT application US 03/24779, filed on 8/8/03, attorney docket no. 25791.125.02, which claims priority from U.S. provisional patent application serial no. 60/407,442, attorney docket no. 25791.125, filed on 8/30/02, (91) U.S. provisional patent application serial no. 60/423,363, attorney docket no. 25791.126, filed on 12/10/02, (92) U.S. provisional patent application serial no. 60/412,196, attorney docket no. 25791.127, filed on 9/20/02, (93) U.S. provisional patent application serial no. 60/412,187, attorney docket no. 25791.128, filed on 9/20/02, (94) U.S. provisional patent application serial no. 60/412,371, attorney docket no. 25791.129, filed on 9/20/02, (95) U.S. patent application serial no. 10/382,325, attorney docket no. 25791.145, filed on 3/5/03, which is a continuation of U.S. patent number 6,557,640, which was filed as patent application serial

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Stage application serial no. 10/549410, attorney docket no. 25791.262.05, filed on 9/13/2005; (165) U.S. Provisional Patent Application No. 60/717391, attorney docket no. 25791.214 filed on 9/15/2005; (166) U.S. National Stage application serial no. 10/550906, attorney docket no. 25791.260.06, filed on 9/27/2005; (167) U.S. National Stage application serial no. 10/551880, attorney docket no. 25791.270.06, filed on 9/30/2005; (168) U.S. National Stage application serial no. 10/552253, attorney docket no. 25791.273.06, filed on 10/4/2005; (169) U.S. National Stage application serial no. 10/552790, attorney docket no. 25791.272.06, filed on 10/11/2005; (170) U.S. Provisional Patent Application No. 60/725181, attorney docket no. 25791.184 filed on 10/11/2005; (171) U.S. National Stage application serial no. 10/553094, attorney docket no. 25791.193.03, filed on 10/13/2005; (172) U.S. National Stage application serial no. 10/553566, attorney docket no. 25791.277.06, filed on 10/17/05; (173) PCT Patent Application No. PCT/US2006/__________, attorney docket no. 25791.324.02 filed on 1/20/06, and (174) PCT Patent Application No. PCT/US2006/__________, attorney docket no. 25791.348.02 filed on 2/9/06; (175) U.S. Utility Patent application serial no. ____________________, attorney docket no. 25791.386, filed on 2/17/06, (176) U.S. National Stage application serial no. _________, attorney docket no. 25791.301.06, filed on ________, (177) U.S. National Stage application serial no. ____________, attorney docket no. 25791.137.04, filed on ___________, (178) U.S. National Stage application serial no. ____________, attorney docket no. 25791.215.06, (179) U.S. National State patent application serial no. _________, attorney docket no. 25791.305.05, filed on ___________; (180) U.S. National State patent application serial no. _________, attorney docket no. 25791.306.04, filed on ___________; (181) U.S. National State patent application serial no. _________, attorney docket no. 25791.307.04, filed on ___________; and (182) U.S. National State patent application serial no. _________, attorney docket no. 25791.308.07, filed on ___________, the disclosures of which are incorporated herein by reference.

Background of the Invention

[006] This invention relates generally to oil and gas exploration, and in particular to forming and repairing wellbore casings to facilitate oil and gas exploration.

Brief Description of the Drawings

[007] Fig. 1 is a fragmentary cross sectional view of an exemplary embodiment of an expandable tubular member positioned within a preexisting structure.

[008] Fig. 2 is a fragmentary cross sectional view of the expandable tubular member of Fig. 1 after positioning an expansion device within the expandable tubular member.

[009] Fig. 3 is a fragmentary cross sectional view of the expandable tubular member of Fig. 2 after operating the expansion device within the expandable tubular member to radially expand and plastically deform a portion of the expandable tubular member.

[0010] Fig. 4 is a fragmentary cross sectional view of the expandable tubular member of Fig. 3 after operating the expansion device within the expandable tubular member to radially expand and plastically deform another portion of the expandable tubular member.

[0011] Fig. 5 is a graphical illustration of exemplary embodiments of the stress/strain curves for several portions of the expandable tubular member of Figs. 1-4.

[0012] Fig. 6 is a graphical illustration of the an exemplary embodiment of the yield strength vs. ductility curve for at least a portion of the expandable tubular member of Figs. 1-4.

[0013] Fig. 7 is a fragmentary cross sectional illustration of an embodiment of a series of overlapping expandable tubular members.

[0014] Fig. 8 is a fragmentary cross sectional view of an exemplary embodiment of an expandable tubular member positioned within a preexisting structure.

[0015] Fig. 9 is a fragmentary cross sectional view of the expandable tubular member of Fig. 8 after positioning an expansion device within the expandable tubular member.

[0016] Fig. 10 is a fragmentary cross sectional view of the expandable tubular member of Fig. 9 after operating the expansion device within the expandable tubular member to radially expand and plastically deform a portion of the expandable tubular member.

[0017] Fig. 11 is a fragmentary cross sectional view of the expandable tubular member of Fig. 10 after operating the expansion device within the expandable tubular member to radially expand and plastically deform another portion of the expandable tubular member.

[0018] Fig. 12 is a graphical illustration of exemplary embodiments of the stress/strain curves for several portions of the expandable tubular member of Figs. 8-11.

[0019] Fig. 13 is a graphical illustration of an exemplary embodiment of the yield strength vs. ductility curve for at least a portion of the expandable tubular member of Figs. 8-11.

[0020] Fig. 14 is a fragmentary cross sectional view of an exemplary embodiment of an expandable tubular member positioned within a preexisting structure.

[0021] Fig. 15 is a fragmentary cross sectional view of the expandable tubular member of Fig. 14 after positioning an expansion device within the expandable tubular member.

[0022] Fig. 16 is a fragmentary cross sectional view of the expandable tubular member of Fig. 15 after operating the expansion device within the expandable tubular member to radially expand and plastically deform a portion of the expandable tubular member.

[0023] Fig. 17 is a fragmentary cross sectional view of the expandable tubular member of Fig. 16 after operating the expansion device within the expandable tubular member to radially expand and plastically deform another portion of the expandable tubular member.

[0024] Fig. 18 is a flow chart illustration of an exemplary embodiment of a method of processing an expandable tubular member.

[0025] Fig. 19 is a graphical illustration of the an exemplary embodiment of the yield strength vs. ductility curve for at least a portion of the expandable tubular member during the

operation of the method of Fig. 18.

[0026] Fig. 20 is a graphical illustration of stress/strain curves for an exemplary embodiment of an expandable tubular member.

[0027] Fig. 21 is a graphical illustration of stress/strain curves for an exemplary embodiment of an expandable tubular member.

[0028] Fig. 22 is a fragmentary cross-sectional view illustrating an embodiment of the radial expansion and plastic deformation of a portion of a first tubular member having an internally threaded connection at an end portion, an embodiment of a tubular sleeve supported by the end portion of the first tubular member, and a second tubular member having an externally threaded portion coupled to the internally threaded portion of the first tubular member and engaged by a flange of the sleeve. The sleeve includes the flange at one end for increasing axial compression loading.

[0029] Fig. 23 is a fragmentary cross-sectional view illustrating an embodiment of the radial expansion and plastic deformation of a portion of a first tubular member having an internally threaded connection at an end portion, a second tubular member having an externally threaded portion coupled to the internally threaded portion of the first tubular member, and an embodiment of a tubular sleeve supported by the end portion of both tubular members. The sleeve includes flanges at opposite ends for increasing axial tension loading.

[0030] Fig. 24 is a fragmentary cross-sectional illustration of the radial expansion and plastic deformation of a portion of a first tubular member having an internally threaded connection at an end portion, a second tubular member having an externally threaded portion coupled to the internally threaded portion of the first tubular member, and an embodiment of a tubular sleeve supported by the end portion of both tubular members. The sleeve includes flanges at opposite ends for increasing axial compression/tension loading.

[0031] Fig. 25 is a fragmentary cross-sectional illustration of the radial expansion and plastic deformation of a portion of a first tubular member having an internally threaded connection at an end portion, a second tubular member having an externally threaded portion coupled to the internally threaded portion of the first tubular member, and an embodiment of a tubular sleeve supported by the end portion of both tubular members. The sleeve includes flanges at opposite ends having sacrificial material thereon.

[0032] Fig. 26 is a fragmentary cross-sectional illustration of the radial expansion and plastic deformation of a portion of a first tubular member having an internally threaded connection at an end portion, a second tubular member having an externally threaded portion coupled to the internally threaded portion of the first tubular member, and an embodiment of a tubular sleeve supported by the end portion of both tubular members. The sleeve includes a thin walled cylinder of sacrificial material.

[0033] Fig. 27 is a fragmentary cross-sectional illustration of the radial expansion and plastic deformation of a portion of a first tubular member having an internally threaded connection at an end portion, a second tubular member having an externally threaded portion coupled to the internally threaded portion of the first tubular member, and an embodiment of a tubular sleeve supported by the end portion of both tubular members. The sleeve includes a variable thickness along the length thereof.

[0034] Fig. 28 is a fragmentary cross-sectional illustration of the radial expansion and plastic deformation of a portion of a first tubular member having an internally threaded connection at an end portion, a second tubular member having an externally threaded portion coupled to the internally threaded portion of the first tubular member, and an embodiment of a tubular sleeve supported by the end portion of both tubular members. The sleeve includes a member coiled onto grooves formed in the sleeve for varying the sleeve thickness.

[0035] Fig. 29 is a fragmentary cross-sectional illustration of an exemplary embodiment of an expandable connection.

[0036] Figs. 30a-30c are fragmentary cross-sectional illustrations of exemplary embodiments of expandable connections.

[0037] Fig. 31 is a fragmentary cross-sectional illustration of an exemplary embodiment of an expandable connection.

[0038] Figs. 32a and 32b are fragmentary cross-sectional illustrations of the formation of an exemplary embodiment of an expandable connection.

[0039] Fig. 33 is a fragmentary cross-sectional illustration of an exemplary embodiment of an expandable connection.

[0040] Figs. 34a, 34b and 34c are fragmentary cross-sectional illustrations of an exemplary embodiment of an expandable connection.

[0041] Fig. 35a is a fragmentary cross-sectional illustration of an exemplary embodiment of an expandable tubular member.

[0042] Fig. 35b is a graphical illustration of an exemplary embodiment of the variation in the yield point for the expandable tubular member of Fig. 35a.

[0043] Fig. 36a is a flow chart illustration of an exemplary embodiment of a method for processing a tubular member.

[0044] Fig. 36b is an illustration of the microstructure of an exemplary embodiment of a tubular member prior to thermal processing.

[0045] Fig. 36c is an illustration of the microstructure of an exemplary embodiment of a tubular member after thermal processing.

[0046] Fig. 37a is a flow chart illustration of an exemplary embodiment of a method for processing a tubular member.

[0047] Fig. 37b is an illustration of the microstructure of an exemplary embodiment of a tubular member prior to thermal processing.

[0048] Fig. 37c is an illustration of the microstructure of an exemplary embodiment of a tubular member after thermal processing.

[0049] Fig. 38a is a flow chart illustration of an exemplary embodiment of a method for processing a tubular member.

[0050] Fig. 38b is an illustration of the microstructure of an exemplary embodiment of a tubular member prior to thermal processing.

[0051] Fig. 38c is an illustration of the microstructure of an exemplary embodiment of a tubular member after thermal processing.

[0052] Fig. 39a is a fragmentary cross sectional illustration of an exemplary embodiment of expandable tubular members positioned within a preexisting structure.

[0053] Fig. 39b is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 39a after placing an adjustable expansion device and a hydroforming expansion device within the expandable tubular members.

[0054] Fig. 39c is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 39b after operating the hydroforming expansion device to radially expand and plastically deform at least a portion of the expandable tubular members.

[0055] Fig. 39d is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 39c after operating the hydroforming expansion device to disengage from the expandable tubular members.

[0056] Fig. 39e is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 39d after positioning the adjustable expansion device within the radially expanded portion of the expandable tubular members and then adjusting the size of the adjustable expansion device.

[0057] Fig. 39f is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 39e after operating the adjustable expansion device to radially expand another portion of the expandable tubular members.

[0058] Fig. 40a is a fragmentary cross sectional illustration of an exemplary embodiment of expandable tubular members positioned within a preexisting structure.

[0059] Fig. 40b is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 40a after placing a hydroforming expansion device within a portion of the expandable tubular members.

[0060] Fig. 40c is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 40b after operating the hydroforming expansion device to radially expand and plastically deform at least a portion of the expandable tubular members.

[0061] Fig. 40d is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 40c after placing the hydroforming expansion device within another portion of the expandable tubular members.

[0062] Fig. 40e is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 40d after operating the hydroforming expansion device to radially expand and plastically deform at least another portion of the expandable tubular members.

[0063] Fig. 40f is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 40e after placing the hydroforming expansion device within another portion of the expandable tubular members.

[0064] Fig. 40g is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 40f after operating the hydroforming expansion device to radially expand and plastically deform at least another portion of the expandable tubular members.

[0065] Fig. 41a is a fragmentary cross sectional illustration of an exemplary embodiment of expandable tubular members positioned within a preexisting structure, wherein the bottom most tubular member includes a valveable passageway.

[0066] Fig. 41b is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41a after placing a hydroforming expansion device within the lower most expandable tubular member.

[0067] Fig. 41c is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41b after operating the hydroforming expansion device to radially expand and plastically deform at least a portion of the lower most expandable tubular member.

[0068] Fig. 41d is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41c after disengaging hydroforming expansion device from the lower most expandable tubular member.

[0069] Fig. 41e is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41d after positioning the adjustable expansion device within the radially expanded and plastically deformed portion of the lower most expandable tubular member.

[0070] Fig. 41f is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41e after operating the adjustable expansion device to engage the radially expanded and plastically deformed portion of the lower most expandable tubular member.

[0071] Fig. 41g is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41f after operating the adjustable expansion device to radially expand and plastically deform at least another portion of the expandable tubular members.

[0072] Fig. 41h is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41g after machining away the lower most portion of the lower most expandable tubular member.

[0073] Fig. 42a is a fragmentary cross sectional illustration of an exemplary embodiment of tubular members positioned within a preexisting structure, wherein one of the tubular members includes one or more radial passages.

[0074] Fig. 42b is a fragmentary cross sectional illustration of the tubular members of Fig. 42a after placing a hydroforming casing patch device within the tubular member having the radial passages.

[0075] Fig. 42c is a fragmentary cross sectional illustration of the tubular members of Fig. 42b after operating the hydroforming expansion device to radially expand and plastically deform a tubular casing patch into engagement with the tubular member having the radial passages.

[0076] Fig. 41d is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41c after disengaging the hydroforming expansion device from the tubular member having the radial passages.

[0077] Fig. 41e is a fragmentary cross sectional illustration of the expandable tubular members of Fig. 41d after removing the hydroforming expansion device from the tubular member having the radial passages.

[0078] Fig. 43 is a schematic illustration of an exemplary embodiment of a hydroforming expansion device.

[0079] Figs. 44a-44b are flow chart illustrations of an exemplary method of operating the hydroforming expansion device of Fig. 43.

[0080] Fig. 45a is a fragmentary cross sectional illustration of an exemplary embodiment of a radial expansion system positioned within a cased section of a wellbore.

[0081] Fig. 45b is a fragmentary cross sectional illustration of the system of Fig. 45a following the placement of a ball within the throat passage of the system.

[0082] Fig. 45c is a fragmentary cross sectional illustration of the system of Fig. 45b during the injection of fluidic materials to burst the burst disc of the system.

[0083] Fig. 45d is a fragmentary cross sectional illustration of the system of Fig. 45c during the continued injection of fluidic materials to radially expand and plastically deform at least a portion of the tubular liner hanger.

[0084] Fig. 45e is a fragmentary cross sectional illustration of the system of Fig. 45d during the continued injection of fluidic materials to adjust the size of the adjustable expansion device assembly.

[0085] Fig. 45f is a fragmentary cross sectional illustration of the system of Fig. 45e during the displacement of the adjustable expansion device assembly to radially expand another portion of the tubular liner hanger.

[0086] Fig. 45g is a fragmentary cross sectional illustration of the system of Fig. 45f following the removal of the system from the wellbore.

[0087] Fig. 46a is a fragmentary cross sectional illustration of an exemplary embodiment of a radial expansion system positioned within a cased section of a wellbore.

[0088] Fig. 46b is a fragmentary cross sectional illustration of the system of Fig. 46a following the placement of a plug within the throat passage of the system.

[0089] Fig. 46c is a fragmentary cross sectional illustration of the system of Fig. 46b during the injection of fluidic materials to burst the burst disc of the system.

[0090] Fig. 46d is a fragmentary cross sectional illustration of the system of Fig. 46c during the continued injection of fluidic materials to radially expand and plastically deform at least a portion of the tubular liner hanger.

[0091] Fig. 46e is a fragmentary cross sectional illustration of the system of Fig. 46d during the continued injection of fluidic materials to adjust the size of the adjustable expansion device assembly.

[0092] Fig. 46f is a fragmentary cross sectional illustration of the system of Fig. 46e during the displacement of the adjustable expansion device assembly to radially expand another portion of the tubular liner hanger.

[0093] Fig. 46g is a top view of a portion of an exemplary embodiment of an expansion limiter sleeve prior to the radial expansion and plastic deformation of the expansion limiter sleeve.

[0094] Fig. 46h is a top view of a portion of the expansion limiter sleeve of Fig. 46g after the radial expansion and plastic deformation of the expansion limiter sleeve.

[0095] Fig. 46i is a top view of a portion of an exemplary embodiment of an expansion limiter sleeve prior to the radial expansion and plastic deformation of the expansion limiter sleeve.

[0096] Fig. 46ia is a fragmentary cross sectional view of the expansion limiter sleeve of Fig. 46i.

[0097] Fig. 46j is a top view of a portion of the expansion limiter sleeve of Fig. 46i after the radial expansion and plastic deformation of the expansion limiter sleeve.

[0098] Fig. 47a is a fragmentary cross sectional illustration of an exemplary embodiment of a system for radially expanding and plastically deforming a tubular member during the injection of a hardenable fluidic sealing material into the system.

[0099] Fig. 47b is a fragmentary cross sectional illustration of the system of Fig. 47a during the subsequent placement of a plug within the flow passages of the system to permit the passages of the system to be pressurized.

[00100] Fig. 47c is a fragmentary cross sectional illustration of the system of Fig. 47b during the subsequent pressurization of the flow passages of the system to operate and displace the expansion cone of the system to radially expand and plastically deform a portion of the expandable tubular casing.

[00101] Fig. 47d is a fragmentary cross sectional illustration of the system of Fig. 47c during the subsequent continued pressurization of the flow passages of the system to operate and displace the expansion cones of the system to radially expand and plastically deform further portions of the expandable tubular casing and a portion of the expandable tubular sleeve.

[00102] Fig. 47e is a fragmentary cross sectional illustration of the system of Fig. 47d during the subsequent pressurization of the flow passages of the system to operate and displace the expansion cone of the system to radially expand and plastically deform further portions of the expandable tubular casing.

[00103] Fig. 48a is a fragmentary cross sectional illustration of an exemplary embodiment of a system for radially expanding and plastically deforming a tubular member during the injection of a hardenable fluidic sealing material into the system.

[00104] Fig. 48b is a fragmentary cross sectional illustration of the system of Fig. 48a during the subsequent placement of a plug within the flow passages of the system to permit the passages of the system to be pressurized.

[00105] Fig. 48c is a fragmentary cross sectional illustration of the system of Fig. 48b during the subsequent pressurization of the flow passages of the system to operate and adjust the size of the adjustable expansion device of the system.

[00106] Fig. 48d is a fragmentary cross sectional illustration of the system of Fig. 48c during the subsequent pressurization of the flow passages of the system to operate and displace the expansion device of the system to radially expand and plastically deform a portion of the expandable tubular casing.

[00107] Fig. 48e is a fragmentary cross sectional illustration of the system of Fig. 48d during the subsequent continued pressurization of the flow passages of the system to operate and displace the expansion device of the system to radially expand and plastically deform further portions of the expandable tubular casing and a portion of the expandable tubular sleeve.

[00108] Fig. 48f is a fragmentary cross sectional illustration of the system of Fig. 48e during the subsequent pressurization of the flow passages of the system to operate and displace the expansion cone of the system to radially expand and plastically deform further portions of the expandable tubular casing.

[00109] Fig. 49a is a fragmentary cross sectional illustration of an exemplary embodiment of a system for radially expanding and plastically deforming a tubular member during the injection of a hardenable fluidic sealing material into the system.

[00110] Fig. 49b is a fragmentary cross sectional illustration of the system of Fig. 49a during the subsequent placement of a plug within the flow passages of the system to permit the passages of the system to be pressurized.

[00111] Fig. 49c is a fragmentary cross sectional illustration of the system of Fig. 49b during the subsequent pressurization of the flow passages of the system to operate and adjust the size of the adjustable expansion device of the system.

[00112] Fig. 49d is a fragmentary cross sectional illustration of the system of Fig. 49c during the subsequent pressurization of the flow passages of the system to operate and displace the expansion device of the system to radially expand and plastically deform a portion of the expandable tubular casing.

[00113] Fig. 49e is a fragmentary cross sectional illustration of the system of Fig. 49d during the subsequent continued pressurization of the flow passages of the system to operate and displace the expansion device of the system to radially expand and plastically deform further portions of the expandable tubular casing and a portion of the expandable tubular sleeve.

[00114] Fig. 49f is a fragmentary cross sectional illustration of the system of Fig. 49e during the subsequent pressurization of the flow passages of the system to operate and displace the expansion cone of the system to radially expand and plastically deform further portions of the expandable tubular casing.

[00115] Fig. 50a is a fragmentary cross sectional illustration of an exemplary embodiment of a system for radially expanding and plastically deforming a tubular member during the injection of a hardenable fluidic sealing material into the system.

[00116] Fig. 50b is a fragmentary cross sectional illustration of the system of Fig. 50a during the subsequent placement of a plug within the flow passages of the system to permit the passages of the system to be pressurized.

[00117] Fig. 50c is a fragmentary cross sectional illustration of the system of Fig. 50b during the subsequent pressurization of the flow passages of the system to operate and adjust the size of the adjustable expansion device of the system to radially expand and plastically deform a portion of the expandable sleeve.

[00118] Fig. 50d is a fragmentary cross sectional illustration of the system of Fig. 50c during the subsequent pressurization of the flow passages of the system to operate and displace the expansion device of the system to radially expand and plastically deform a portion of the expandable tubular casing and release the expandable tubular casing from engagement with the casing lock assembly.

[00119] Fig. 50e is a fragmentary cross sectional illustration of the system of Fig. 50d during the subsequent continued pressurization of the flow passages of the system to operate and displace the expansion device of the system to radially expand and plastically deform further portions of the expandable tubular casing.

[00120] Fig. 50f is a fragmentary cross sectional illustration of the system of Fig. 50b during an emergency release of the expandable tubular casing from engagement with the locking dogs of the casing lock assembly.

[00121] Fig. 51 is a schematic fragmentary cross-sectional view along a plane along and through the central axis of a tubular member that is tested to failure with axial opposed forces.

[00122] Fig. 52 is a stress-strain curve representing values for stress and strain that may be plotted for solid specimen sample.

[00123] Fig. 53 is a schematically depiction of a stress strain curve representing values from an exemplary test on a tubular member.

[00124] Fig. 54 is a graphical illustration of an exemplary experimental embodiment.

[00125] Fig. 55 is a graphical illustration of an exemplary experimental embodiment.

[00126] Fig. 56 is a flow chart illustration of an exemplary embodiment of a method of processing tubular members.

[00127] Fig. 57 is a graphical illustration of an exemplary embodiment of a method of processing tubular members.

[00128] Fig. 58 is a graphical illustration of an exemplary embodiment of a method of processing tubular members.

[00129] Fig. 59 is a graphical illustration of an exemplary embodiment of a method of processing tubular members.

Detailed Description of the Illustrative Embodiments

[00130] Referring initially to Fig. 1, an exemplary embodiment of an expandable tubular assembly 10 includes a first expandable tubular member 12 coupled to a second expandable tubular member 14. In several exemplary embodiments, the ends of the first and second expandable tubular members, 12 and 14, are coupled using, for example, a conventional mechanical coupling, a welded connection, a brazed connection, a threaded connection, and/or an interference fit connection. In an exemplary embodiment, the first expandable tubular member 12 has a plastic yield point YP_1, and the second expandable tubular member 14 has a plastic yield point YP_2. In an exemplary embodiment, the expandable tubular assembly 10 is positioned within a preexisting structure such as, for example, a wellbore 16 that traverses a subterranean formation 18.

[00131] As illustrated in Fig. 2, an expansion device 20 may then be positioned within the second expandable tubular member 14. In several exemplary embodiments, the expansion device 20 may include, for example, one or more of the following conventional expansion devices: a) an expansion cone; b) a rotary expansion device; c) a hydroforming expansion device; d) an impulsive force expansion device; d) any one of the expansion devices commercially available from, or disclosed in any of the published patent applications or

issued patents, of Weatherford International, Baker Hughes, Halliburton Energy Services, Shell Oil Co., Schlumberger, and/or Enventure Global Technology L.L.C. In several exemplary embodiments, the expansion device 20 is positioned within the second expandable tubular member 14 before, during, or after the placement of the expandable tubular assembly 10 within the preexisting structure 16.

[00132] As illustrated in Fig. 3, the expansion device 20 may then be operated to radially expand and plastically deform at least a portion of the second expandable tubular member 14 to form a bell-shaped section.

[00133] As illustrated in Fig. 4, the expansion device 20 may then be operated to radially expand and plastically deform the remaining portion of the second expandable tubular member 14 and at least a portion of the first expandable tubular member 12.

[00134] In an exemplary embodiment, at least a portion of at least a portion of at least one of the first and second expandable tubular members, 12 and 14, are radially expanded into intimate contact with the interior surface of the preexisting structure 16.

[00135] In an exemplary embodiment, as illustrated in Fig. 5, the plastic yield point YP_1 is greater than the plastic yield point YP_2. In this manner, in an exemplary embodiment, the amount of power and/or energy required to radially expand the second expandable tubular member 14 is less than the amount of power and/or energy required to radially expand the first expandable tubular member 12.

[00136] In an exemplary embodiment, as illustrated in Fig. 6, the first expandable tubular member 12 and/or the second expandable tubular member 14 have a ductility D_{PE} and a yield strength YS_{PE} prior to radial expansion and plastic deformation, and a ductility D_{AE} and a yield strength YS_{AE} after radial expansion and plastic deformation. In an exemplary embodiment, D_{PE} is greater than D_{AE}, and YS_{AE} is greater than YS_{PE}. In this manner, the first expandable tubular member 12 and/or the second expandable tubular member 14 are transformed during the radial expansion and plastic deformation process. Furthermore, in this manner, in an exemplary embodiment, the amount of power and/or energy required to radially expand each unit length of the first and/or second expandable tubular members, 12 and 14, is reduced. Furthermore, because the YS_{AE} is greater than YS_{PE}, the collapse strength of the first expandable tubular member 12 and/or the second expandable tubular member 14 is increased after the radial expansion and plastic deformation process.

[00137] In an exemplary embodiment, as illustrated in Fig. 7, following the completion of the radial expansion and plastic deformation of the expandable tubular assembly 10 described above with reference to Figs. 1-4, at least a portion of the second expandable tubular member 14 has an inside diameter that is greater than at least the inside diameter of the first expandable tubular member 12. In this manner a bell-shaped section is formed using at least a portion of the second expandable tubular member 14. Another expandable

tubular assembly 22 that includes a first expandable tubular member 24 and a second expandable tubular member 26 may then be positioned in overlapping relation to the first expandable tubular assembly 10 and radially expanded and plastically deformed using the methods described above with reference to Figs. 1-4. Furthermore, following the completion of the radial expansion and plastic deformation of the expandable tubular assembly 20, in an exemplary embodiment, at least a portion of the second expandable tubular member 26 has an inside diameter that is greater than at least the inside diameter of the first expandable tubular member 24. In this manner a bell-shaped section is formed using at least a portion of the second expandable tubular member 26. Furthermore, in this manner, a mono-diameter tubular assembly is formed that defines an internal passage 28 having a substantially constant cross-sectional area and/or inside diameter.

[00138] Referring to Fig. 8, an exemplary embodiment of an expandable tubular assembly 100 includes a first expandable tubular member 102 coupled to a tubular coupling 104. The tubular coupling 104 is coupled to a tubular coupling 106. The tubular coupling 106 is coupled to a second expandable tubular member 108. In several exemplary embodiments, the tubular couplings, 104 and 106, provide a tubular coupling assembly for coupling the first and second expandable tubular members, 102 and 108, together that may include, for example, a conventional mechanical coupling, a welded connection, a brazed connection, a threaded connection, and/or an interference fit connection. In an exemplary embodiment, the first and second expandable tubular members 12 have a plastic yield point YP_1, and the tubular couplings, 104 and 106, have a plastic yield point YP_2. In an exemplary embodiment, the expandable tubular assembly 100 is positioned within a preexisting structure such as, for example, a wellbore 110 that traverses a subterranean formation 112.

[00139] As illustrated in Fig. 9, an expansion device 114 may then be positioned within the second expandable tubular member 108. In several exemplary embodiments, the expansion device 114 may include, for example, one or more of the following conventional expansion devices: a) an expansion cone; b) a rotary expansion device; c) a hydroforming expansion device; d) an impulsive force expansion device; d) any one of the expansion devices commercially available from, or disclosed in any of the published patent applications or issued patents, of Weatherford International, Baker Hughes, Halliburton Energy Services, Shell Oil Co., Schlumberger, and/or Enventure Global Technology L.L.C. In several exemplary embodiments, the expansion device 114 is positioned within the second expandable tubular member 108 before, during, or after the placement of the expandable tubular assembly 100 within the preexisting structure 110.

[00140] As illustrated in Fig. 10, the expansion device 114 may then be operated to radially expand and plastically deform at least a portion of the second expandable tubular member 108 to form a bell-shaped section.

[00141] As illustrated in Fig. 11, the expansion device 114 may then be operated to radially expand and plastically deform the remaining portion of the second expandable tubular member 108, the tubular couplings, 104 and 106, and at least a portion of the first expandable tubular member 102.

[00142] In an exemplary embodiment, at least a portion of at least a portion of at least one of the first and second expandable tubular members, 102 and 108, are radially expanded into intimate contact with the interior surface of the preexisting structure 110.

[00143] In an exemplary embodiment, as illustrated in Fig. 12, the plastic yield point YP_1 is less than the plastic yield point YP_2. In this manner, in an exemplary embodiment, the amount of power and/or energy required to radially expand each unit length of the first and second expandable tubular members, 102 and 108, is less than the amount of power and/or energy required to radially expand each unit length of the tubular couplings, 104 and 106.

[00144] In an exemplary embodiment, as illustrated in Fig. 13, the first expandable tubular member 12 and/or the second expandable tubular member 14 have a ductility D_{PE} and a yield strength YS_{PE} prior to radial expansion and plastic deformation, and a ductility D_{AE} and a yield strength YS_{AE} after radial expansion and plastic deformation. In an exemplary embodiment, D_{PE} is greater than D_{AE}, and YS_{AE} is greater than YS_{PE}. In this manner, the first expandable tubular member 12 and/or the second expandable tubular member 14 are transformed during the radial expansion and plastic deformation process. Furthermore, in this manner, in an exemplary embodiment, the amount of power and/or energy required to radially expand each unit length of the first and/or second expandable tubular members, 12 and 14, is reduced. Furthermore, because the YS_{AE} is greater than YS_{PE}, the collapse strength of the first expandable tubular member 12 and/or the second expandable tubular member 14 is increased after the radial expansion and plastic deformation process.

[00145] Referring to Fig. 14, an exemplary embodiment of an expandable tubular assembly 200 includes a first expandable tubular member 202 coupled to a second expandable tubular member 204 that defines radial openings 204a, 204b, 204c, and 204d. In several exemplary embodiments, the ends of the first and second expandable tubular members, 202 and 204, are coupled using, for example, a conventional mechanical coupling, a welded connection, a brazed connection, a threaded connection, and/or an interference fit connection. In an exemplary embodiment, one or more of the radial openings, 204a, 204b, 204c, and 204d, have circular, oval, square, and/or irregular cross sections and/or include portions that extend to and interrupt either end of the second expandable tubular member 204. In an exemplary embodiment, the expandable tubular assembly 200 is positioned within a preexisting structure such as, for example, a wellbore 206 that traverses a subterranean formation 208.

[00146] As illustrated in Fig. 15, an expansion device 210 may then be positioned within

the second expandable tubular member 204. In several exemplary embodiments, the expansion device 210 may include, for example, one or more of the following conventional expansion devices: a) an expansion cone; b) a rotary expansion device; c) a hydroforming expansion device; d) an impulsive force expansion device; d) any one of the expansion devices commercially available from, or disclosed in any of the published patent applications or issued patents, of Weatherford International, Baker Hughes, Halliburton Energy Services, Shell Oil Co., Schlumberger, and/or Enventure Global Technology L.L.C. In several exemplary embodiments, the expansion device 210 is positioned within the second expandable tubular member 204 before, during, or after the placement of the expandable tubular assembly 200 within the preexisting structure 206.

[00147] As illustrated in Fig. 16, the expansion device 210 may then be operated to radially expand and plastically deform at least a portion of the second expandable tubular member 204 to form a bell-shaped section.

[00148] As illustrated in Fig. 16, the expansion device 20 may then be operated to radially expand and plastically deform the remaining portion of the second expandable tubular member 204 and at least a portion of the first expandable tubular member 202.

[00149] In an exemplary embodiment, the anisotropy ratio ("AR") for the first and second expandable tubular members is defined by the following equation:

$AR = \ln (WT_f/WT_o)/\ln (D_f/D_o)$;

where AR = anisotropy ratio;

where WT_f = final wall thickness of the expandable tubular member following the radial expansion and plastic deformation of the expandable tubular member;

where WT_i = initial wall thickness of the expandable tubular member prior to the radial expansion and plastic deformation of the expandable tubular member;

where D_f = final inside diameter of the expandable tubular member following the radial expansion and plastic deformation of the expandable tubular member; and

where D_i = initial inside diameter of the expandable tubular member prior to the radial expansion and plastic deformation of the expandable tubular member.

[00150] In an exemplary embodiment, the anisotropy ratio for the first and/or second expandable tubular members, 204 and 204, is greater than 1.

[00151] In an exemplary experimental embodiment, the second expandable tubular member 204 had an anisotropy ratio greater than 1, and the radial expansion and plastic deformation of the second expandable tubular member did not result in any of the openings, 204a, 204b, 204c, and 204d, splitting or otherwise fracturing the remaining portions of the second expandable tubular member. This was an unexpected result.

[00152] Referring to Fig. 18, in an exemplary embodiment, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204 are processed using a

method 300 in which a tubular member in an initial state is thermo-mechanically processed in step 302. In an exemplary embodiment, the thermo-mechanical processing 302 includes one or more heat treating and/or mechanical forming processes. As a result, of the thermo-mechanical processing 302, the tubular member is transformed to an intermediate state. The tubular member is then further thermo-mechanically processed in step 304. In an exemplary embodiment, the thermo-mechanical processing 304 includes one or more heat treating and/or mechanical forming processes. As a result, of the thermo-mechanical processing 304, the tubular member is transformed to a final state.

[00153] In an exemplary embodiment, as illustrated in Fig. 19, during the operation of the method 300, the tubular member has a ductility D_{PE} and a yield strength YS_{PE} prior to the final thermo-mechanical processing in step 304, and a ductility D_{AE} and a yield strength YS_{AE} after final thermo-mechanical processing. In an exemplary embodiment, D_{PE} is greater than D_{AE}, and YS_{AE} is greater than YS_{PE}. In this manner, the amount of energy and/or power required to transform the tubular member, using mechanical forming processes, during the final thermo-mechanical processing in step 304 is reduced. Furthermore, in this manner, because the YS_{AE} is greater than YS_{PE}, the collapse strength of the tubular member is increased after the final thermo-mechanical processing in step 304.

[00154] In an exemplary embodiment, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204, have the following characteristics:

Characteristic	Value
Tensile Strength	60 to 120 ksi
Yield Strength	50 to 100 ksi
Y/T Ratio	Maximum of 50/85 %
Elongation During Radial Expansion and Plastic Deformation	Minimum of 35 %
Width Reduction During Radial Expansion and Plastic Deformation	Minimum of 40 %
Wall Thickness Reduction During Radial Expansion and Plastic Deformation	Minimum of 30 %
Anisotropy	Minimum of 1.5

Characteristic	Value
Minimum Absorbed Energy at -4 F (-20 C) in the Longitudinal Direction	80 ft-lb
Minimum Absorbed Energy at -4 F (-20 C) in the Transverse Direction	60 ft-lb
Minimum Absorbed Energy at -4 F (-20 C) Transverse To A Weld Area	60 ft-lb
Flare Expansion Testing	Minimum of 75% Without A Failure
Increase in Yield Strength Due To Radial Expansion and Plastic Deformation	Greater than 5.4 %

[00155] In an exemplary embodiment, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204, are characterized by an expandability coefficient f:

i. f = r X n

ii. where f = expandability coefficient;

1. r = anisotropy ratio; and
2. n = strain hardening exponent.

[00156] In an exemplary embodiment, the anisotropy ratio for one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204 is greater than 1. In an exemplary embodiment, the strain hardening exponent for one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204 is greater than 0.12. In an exemplary embodiment, the expandability coefficient for one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204 is greater than 0.12.

[00157] In an exemplary embodiment, a tubular member having a higher expandability coefficient requires less power and/or energy to radially expand and plastically deform each unit length than a tubular member having a lower expandability coefficient. In an exemplary embodiment, a tubular member having a higher expandability coefficient requires less power and/or energy per unit length to radially expand and plastically deform than a tubular member having a lower expandability coefficient.

[00158] In several exemplary experimental embodiments, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204, are steel alloys having one of the following compositions:

	Element and Percentage By Weight							
Steel Alloy	**C**	**Mn**	**P**	**S**	**Si**	**Cu**	**Ni**	**Cr**
A	0.065	1.44	0.01	0.002	0.24	0.01	0.01	0.02
B	0.18	1.28	0.017	0.004	0.29	0.01	0.01	0.03
C	0.08	0.82	0.006	0.003	0.30	0.16	0.05	0.05
D	0.02	1.31	0.02	0.001	0.45	-	9.1	18.7

[00159] In exemplary experimental embodiment, as illustrated in Fig. 20, a sample of an expandable tubular member composed of Alloy A exhibited a yield point before radial expansion and plastic deformation YP_{BE}, a yield point after radial expansion and plastic deformation of about 16 % $YP_{AE16\%}$, and a yield point after radial expansion and plastic deformation of about 24 % $YP_{AE24\%}$. In an exemplary experimental embodiment, $YP_{AE24\%} > YP_{AE16\%} > YP_{BE}$. Furthermore, in an exemplary experimental embodiment, the ductility of the sample of the expandable tubular member composed of Alloy A also exhibited a higher ductility prior to radial expansion and plastic deformation than after radial expansion and plastic deformation. These were unexpected results.

[00160] In an exemplary experimental embodiment, a sample of an expandable tubular member composed of Alloy A exhibited the following tensile characteristics before and after radial expansion and plastic deformation:

	Yield Point ksi	**Yield Ratio**	**Elongation %**	**Width Reduction %**	**Wall Thickness Reduction %**	**Anisotropy**
Before Radial Expansion and Plastic Deformation	46.9	0.69	53	-52	55	0.93
After 16% Radial Expansion	65.9	0.83	17	42	51	0.78
After 24% Radial Expansion	68.5	0.83	5	44	54	0.76

	Yield Point ksi	Yield Ratio	Elongation %	Width Reduction %	Wall Thickness Reduction %	Anisotropy
% Increase	40% for 16% radial expansion 46% for 24% radial expansion					

[00161] In exemplary experimental embodiment, as illustrated in Fig. 21, a sample of an expandable tubular member composed of Alloy B exhibited a yield point before radial expansion and plastic deformation YP_{BE}, a yield point after radial expansion and plastic deformation of about 16 % $YP_{AE16\%}$, and a yield point after radial expansion and plastic deformation of about 24 % $YP_{AE24\%}$. In an exemplary embodiment, $YP_{AE24\%} > YP_{AE16\%} > YP_{BE}$. Furthermore, in an exemplary experimental embodiment, the ductility of the sample of the expandable tubular member composed of Alloy B also exhibited a higher ductility prior to radial expansion and plastic deformation than after radial expansion and plastic deformation. These were unexpected results.

[00162] In an exemplary experimental embodiment, a sample of an expandable tubular member composed of Alloy B exhibited the following tensile characteristics before and after radial expansion and plastic deformation:

	Yield Point ksi	Yield Ratio	Elongation %	Width Reduction %	Wall Thickness Reduction %	Anisotropy
Before Radial Expansion and Plastic Deformation	57.8	0.71	44	43	46	0.93
After 16% Radial	74.4	0.84	16	38	42	0.87

	Yield Point ksi	Yield Ratio	Elongation %	Width Reduction %	Wall Thickness Reduction %	Anisotropy
Expansion						
After 24% Radial Expansion	79.8	0.86	20	36	42	0.81
% Increase	28.7% increase for 16% radial expansion 38% increase for 24% radial expansion					

[00163] In an exemplary experimental embodiment, samples of expandable tubulars composed of Alloys A, B, C, and D exhibited the following tensile characteristics prior to radial expansion and plastic deformation:

Steel Alloy	Yield ksi	Yield Ratio	Elongation %	Anisotropy	Absorbed Energy ft-lb	Expandability Coefficient
A	47.6	0.71	44	1.48	145	
B	57.8	0.71	44	1.04	62.2	
C	61.7	0.80	39	1.92	268	
D	48	0.55	56	1.34	-	

[00164] In an exemplary embodiment, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204 have a strain hardening exponent greater than 0.12, and a yield ratio is less than 0.85.

[00165] In an exemplary embodiment, the carbon equivalent C_e, for tubular members having a carbon content (by weight percentage) less than or equal to 0.12%, is given by the following expression:

$$C_e = C + Mn/6 + (Cr + Mo + V + Ti + Nb)/5 + (Ni + Cu)/15$$

where C_e = carbon equivalent value;

a. C = carbon percentage by weight;

b. Mn = manganese percentage by weight;

c. Cr = chromium percentage by weight;

d. Mo = molybdenum percentage by weight;

e. V = vanadium percentage by weight;

f. Ti = titanium percentage by weight;

g. Nb = niobium percentage by weight;

h. Ni = nickel percentage by weight; and

i. Cu = copper percentage by weight.

[00166] In an exemplary embodiment, the carbon equivalent value C_e, for tubular members having a carbon content less than or equal to 0.12% (by weight), for one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204 is less than 0.21.

[00167] In an exemplary embodiment, the carbon equivalent C_e, for tubular members having more than 0.12% carbon content (by weight), is given by the following expression:

$$C_e = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5*B$$

where C_e = carbon equivalent value;

a. C = carbon percentage by weight;

b. Si = silicon percentage by weight;

c. Mn = manganese percentage by weight;

d. Cu = copper percentage by weight;

e. Cr = chromium percentage by weight;

f. Ni = nickel percentage by weight;

g. Mo = molybdenum percentage by weight;

h. V = vanadium percentage by weight; and

i. B = boron percentage by weight.

[00168] In an exemplary embodiment, the carbon equivalent value C_e, for tubular members having greater than 0.12% carbon content (by weight), for one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204 is less than 0.36.

[00169] Referring to Fig. 22 in an exemplary embodiment, a first tubular member 2210 includes an internally threaded connection 2212 at an end portion 2214. A first end of a tubular sleeve 2216 that includes an internal flange 2218 having a tapered portion 2220, and a second end that includes a tapered portion 2222, is then mounted upon and receives the

end portion 2214 of the first tubular member 2210. In an exemplary embodiment, the end portion 2214 of the first tubular member 2210 abuts one side of the internal flange 2218 of the tubular sleeve 2216, and the internal diameter of the internal flange 2218 of the tubular sleeve 2216 is substantially equal to or greater than the maximum internal diameter of the internally threaded connection 2212 of the end portion 2214 of the first tubular member 2210. An externally threaded connection 2224 of an end portion 2226 of a second tubular member 2228 having an annular recess 2230 is then positioned within the tubular sleeve 2216 and threadably coupled to the internally threaded connection 2212 of the end portion 2214 of the first tubular member 2210. In an exemplary embodiment, the internal flange 2218 of the tubular sleeve 2216 mates with and is received within the annular recess 2230 of the end portion 2226 of the second tubular member 2228. Thus, the tubular sleeve 2216 is coupled to and surrounds the external surfaces of the first and second tubular members, 2210 and 2228.

[00170] The internally threaded connection 2212 of the end portion 2214 of the first tubular member 2210 is a box connection, and the externally threaded connection 2224 of the end portion 2226 of the second tubular member 2228 is a pin connection. In an exemplary embodiment, the internal diameter of the tubular sleeve 2216 is at least approximately .020" greater than the outside diameters of the first and second tubular members, 2210 and 2228. In this manner, during the threaded coupling of the first and second tubular members, 2210 and 2228, fluidic materials within the first and second tubular members may be vented from the tubular members.

[00171] As illustrated in Fig. 22, the first and second tubular members, 2210 and 2228, and the tubular sleeve 2216 may be positioned within another structure 2232 such as, for example, a cased or uncased wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating a conventional expansion device 2234 within and/or through the interiors of the first and second tubular members. The tapered portions, 2220 and 2222, of the tubular sleeve 2216 facilitate the insertion and movement of the first and second tubular members within and through the structure 2232, and the movement of the expansion device 2234 through the interiors of the first and second tubular members, 2210 and 2228, may be, for example, from top to bottom or from bottom to top.

[00172] During the radial expansion and plastic deformation of the first and second tubular members, 2210 and 2228, the tubular sleeve 2216 is also radially expanded and plastically deformed. As a result, the tubular sleeve 2216 may be maintained in circumferential tension and the end portions, 2214 and 2226, of the first and second tubular members, 2210 and 2228, may be maintained in circumferential compression.

[00173] Sleeve 2216 increases the axial compression loading of the connection between tubular members 2210 and 2228 before and after expansion by the expansion

device 2234. Sleeve 2216 may, for example, be secured to tubular members 2210 and 2228 by a heat shrink fit.

[00174] In several alternative embodiments, the first and second tubular members, 2210 and 2228, are radially expanded and plastically deformed using other conventional methods for radially expanding and plastically deforming tubular members such as, for example, internal pressurization, hydroforming, and/or roller expansion devices and/or any one or combination of the conventional commercially available expansion products and services available from Baker Hughes, Weatherford International, and/or Enventure Global Technology L.L.C.

[00175] The use of the tubular sleeve 2216 during (a) the coupling of the first tubular member 2210 to the second tubular member 2228, (b) the placement of the first and second tubular members in the structure 2232, and (c) the radial expansion and plastic deformation of the first and second tubular members provides a number of significant benefits. For example, the tubular sleeve 2216 protects the exterior surfaces of the end portions, 2214 and 2226, of the first and second tubular members, 2210 and 2228, during handling and insertion of the tubular members within the structure 2232. In this manner, damage to the exterior surfaces of the end portions, 2214 and 2226, of the first and second tubular members, 2210 and 2228, is avoided that could otherwise result in stress concentrations that could cause a catastrophic failure during subsequent radial expansion operations. Furthermore, the tubular sleeve 2216 provides an alignment guide that facilitates the insertion and threaded coupling of the second tubular member 2228 to the first tubular member 2210. In this manner, misalignment that could result in damage to the threaded connections, 2212 and 2224, of the first and second tubular members, 2210 and 2228, may be avoided. In addition, during the relative rotation of the second tubular member with respect to the first tubular member, required during the threaded coupling of the first and second tubular members, the tubular sleeve 2216 provides an indication of to what degree the first and second tubular members are threadably coupled. For example, if the tubular sleeve 2216 can be easily rotated, that would indicate that the first and second tubular members, 2210 and 2228, are not fully threadably coupled and in intimate contact with the internal flange 2218 of the tubular sleeve. Furthermore, the tubular sleeve 2216 may prevent crack propagation during the radial expansion and plastic deformation of the first and second tubular members, 2210 and 2228. In this manner, failure modes such as, for example, longitudinal cracks in the end portions, 2214 and 2226, of the first and second tubular members may be limited in severity or eliminated all together. In addition, after completing the radial expansion and plastic deformation of the first and second tubular members, 2210 and 2228, the tubular sleeve 2216 may provide a fluid tight metal-to-metal seal between interior surface of the tubular sleeve 2216 and the exterior surfaces of the end

portions, 2214 and 2226, of the first and second tubular members. In this manner, fluidic materials are prevented from passing through the threaded connections, 2212 and 2224, of the first and second tubular members, 2210 and 2228, into the annulus between the first and second tubular members and the structure 2232. Furthermore, because, following the radial expansion and plastic deformation of the first and second tubular members, 2210 and 2228, the tubular sleeve 2216 may be maintained in circumferential tension and the end portions, 2214 and 2226, of the first and second tubular members, 2210 and 2228, may be maintained in circumferential compression, axial loads and/or torque loads may be transmitted through the tubular sleeve.

[00176] In several exemplary embodiments, one or more portions of the first and second tubular members, 2210 and 2228, and the tubular sleeve 2216 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00177] Referring to Fig. 23, in an exemplary embodiment, a first tubular member 210 includes an internally threaded connection 2312 at an end portion 2314. A first end of a tubular sleeve 2316 includes an internal flange 2318 and a tapered portion 2320. A second end of the sleeve 2316 includes an internal flange 2321 and a tapered portion 2322. An externally threaded connection 2324 of an end portion 2326 of a second tubular member 2328 having an annular recess 2330, is then positioned within the tubular sleeve 2316 and threadably coupled to the internally threaded connection 2312 of the end portion 2314 of the first tubular member 2310. The internal flange 2318 of the sleeve 2316 mates with and is received within the annular recess 2330.

[00178] The first tubular member 2310 includes a recess 2331. The internal flange 2321 mates with and is received within the annular recess 2331. Thus, the sleeve 2316 is coupled to and surrounds the external surfaces of the first and second tubular members 2310 and 2328.

[00179] The internally threaded connection 2312 of the end portion 2314 of the first tubular member 2310 is a box connection, and the externally threaded connection 2324 of the end portion 2326 of the second tubular member 2328 is a pin connection. In an exemplary embodiment, the internal diameter of the tubular sleeve 2316 is at least approximately .020" greater than the outside diameters of the first and second tubular members 2310 and 2328. In this manner, during the threaded coupling of the first and second tubular members 2310 and 2328, fluidic materials within the first and second tubular members may be vented from the tubular members.

[00180] As illustrated in Fig. 23, the first and second tubular members 2310 and 2328, and the tubular sleeve 2316 may then be positioned within another structure 2332 such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by

displacing and/or rotating an expansion device 2334 through and/or within the interiors of the first and second tubular members. The tapered portions 2320 and 2322, of the tubular sleeve 2316 facilitates the insertion and movement of the first and second tubular members within and through the structure 2332, and the displacement of the expansion device 2334 through the interiors of the first and second tubular members 2310 and 2328, may be from top to bottom or from bottom to top.

[00181] During the radial expansion and plastic deformation of the first and second tubular members 2310 and 2328, the tubular sleeve 2316 is also radially expanded and plastically deformed. In an exemplary embodiment, as a result, the tubular sleeve 2316 may be maintained in circumferential tension and the end portions 2314 and 2326, of the first and second tubular members 2310 and 2328, may be maintained in circumferential compression.

[00182] Sleeve 2316 increases the axial tension loading of the connection between tubular members 2310 and 2328 before and after expansion by the expansion device 2334. Sleeve 2316 may be secured to tubular members 2310 and 2328 by a heat shrink fit.

[00183] In several exemplary embodiments, one or more portions of the first and second tubular members, 2310 and 2328, and the tubular sleeve 2316 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00184] Referring to Fig. 24, in an exemplary embodiment, a first tubular member 2410 includes an internally threaded connection 2412 at an end portion 2414. A first end of a tubular sleeve 2416 includes an internal flange 2418 and a tapered portion 2420. A second end of the sleeve 2416 includes an internal flange 2421 and a tapered portion 2422. An externally threaded connection 2424 of an end portion 2426 of a second tubular member 2428 having an annular recess 2430, is then positioned within the tubular sleeve 2416 and threadably coupled to the internally threaded connection 2412 of the end portion 2414 of the first tubular member 2410. The internal flange 2418 of the sleeve 2416 mates with and is received within the annular recess 2430. The first tubular member 2410 includes a recess 2431. The internal flange 2421 mates with and is received within the annular recess 2431. Thus, the sleeve 2416 is coupled to and surrounds the external surfaces of the first and second tubular members 2410 and 2428.

[00185] The internally threaded connection 2412 of the end portion 2414 of the first tubular member 2410 is a box connection, and the externally threaded connection 2424 of the end portion 2426 of the second tubular member 2428 is a pin connection. In an exemplary embodiment, the internal diameter of the tubular sleeve 2416 is at least approximately .020" greater than the outside diameters of the first and second tubular members 2410 and 2428. In this manner, during the threaded coupling of the first and

second tubular members 2410 and 2428, fluidic materials within the first and second tubular members may be vented from the tubular members.

[00186] As illustrated in Fig. 24, the first and second tubular members 2410 and 2428, and the tubular sleeve 2416 may then be positioned within another structure 2432 such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device 2434 through and/or within the interiors of the first and second tubular members. The tapered portions 2420 and 2422, of the tubular sleeve 2416 facilitate the insertion and movement of the first and second tubular members within and through the structure 2432, and the displacement of the expansion device 2434 through the interiors of the first and second tubular members, 2410 and 2428, may be from top to bottom or from bottom to top.

[00187] During the radial expansion and plastic deformation of the first and second tubular members, 2410 and 2428, the tubular sleeve 2416 is also radially expanded and plastically deformed. In an exemplary embodiment, as a result, the tubular sleeve 2416 may be maintained in circumferential tension and the end portions, 2414 and 2426, of the first and second tubular members, 2410 and 2428, may be maintained in circumferential compression.

[00188] The sleeve 2416 increases the axial compression and tension loading of the connection between tubular members 2410 and 2428 before and after expansion by expansion device 2424. Sleeve 2416 may be secured to tubular members 2410 and 2428 by a heat shrink fit.

[00189] In several exemplary embodiments, one or more portions of the first and second tubular members, 2410 and 2428, and the tubular sleeve 2416 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00190] Referring to Fig. 25, in an exemplary embodiment, a first tubular member 2510 includes an internally threaded connection 2512 at an end portion 2514. A first end of a tubular sleeve 2516 includes an internal flange 2518 and a relief 2520. A second end of the sleeve 2516 includes an internal flange 2521 and a relief 2522. An externally threaded connection 2524 of an end portion 2526 of a second tubular member 2528 having an annular recess 2530, is then positioned within the tubular sleeve 2516 and threadably coupled to the internally threaded connection 2512 of the end portion 2514 of the first tubular member 2510. The internal flange 2518 of the sleeve 2516 mates with and is received within the annular recess 2530. The first tubular member 2510 includes a recess 2531. The internal flange 2521 mates with and is received within the annular recess 2531. Thus, the sleeve 2516 is coupled to and surrounds the external surfaces of the first and second tubular members 2510 and 2528.

[00191] The internally threaded connection 2512 of the end portion 2514 of the first tubular member 2510 is a box connection, and the externally threaded connection 2524 of the end portion 2526 of the second tubular member 2528 is a pin connection. In an exemplary embodiment, the internal diameter of the tubular sleeve 2516 is at least approximately .020" greater than the outside diameters of the first and second tubular members 2510 and 2528. In this manner, during the threaded coupling of the first and second tubular members 2510 and 2528, fluidic materials within the first and second tubular members may be vented from the tubular members.

[00192] As illustrated in Fig. 25, the first and second tubular members 2510 and 2528, and the tubular sleeve 2516 may then be positioned within another structure 2532 such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device 2534 through and/or within the interiors of the first and second tubular members. The reliefs 2520 and 2522 are each filled with a sacrificial material 2540 including a tapered surface 2542 and 2544, respectively. The material 2540 may be a metal or a synthetic, and is provided to facilitate the insertion and movement of the first and second tubular members 2510 and 2528, through the structure 2532. The displacement of the expansion device 2534 through the interiors of the first and second tubular members 2510 and 2528, may, for example, be from top to bottom or from bottom to top.

[00193] During the radial expansion and plastic deformation of the first and second tubular members 2510 and 2528, the tubular sleeve 2516 is also radially expanded and plastically deformed. In an exemplary embodiment, as a result, the tubular sleeve 2516 may be maintained in circumferential tension and the end portions 2514 and 2526, of the first and second tubular members, 2510 and 2528, may be maintained in circumferential compression.

[00194] The addition of the sacrificial material 2540, provided on sleeve 2516, avoids stress risers on the sleeve 2516 and the tubular member 2510. The tapered surfaces 2542 and 2544 are intended to wear or even become damaged, thus incurring such wear or damage which would otherwise be borne by sleeve 2516. Sleeve 2516 may be secured to tubular members 2510 and 2528 by a heat shrink fit.

[00195] In several exemplary embodiments, one or more portions of the first and second tubular members, 2510 and 2528, and the tubular sleeve 2516 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00196] Referring to Fig. 26, in an exemplary embodiment, a first tubular member 2610 includes an internally threaded connection 2612 at an end portion 2614. A first end of a tubular sleeve 2616 includes an internal flange 2618 and a tapered portion 2620. A

second end of the sleeve 2616 includes an internal flange 2621 and a tapered portion 2622. An externally threaded connection 2624 of an end portion 2626 of a second tubular member 2628 having an annular recess 2630, is then positioned within the tubular sleeve 2616 and threadably coupled to the internally threaded connection 2612 of the end portion 2614 of the first tubular member 2610. The internal flange 2618 of the sleeve 2616 mates with and is received within the annular recess 2630.

[00197] The first tubular member 2610 includes a recess 2631. The internal flange 2621 mates with and is received within the annular recess 2631. Thus, the sleeve 2616 is coupled to and surrounds the external surfaces of the first and second tubular members 2610 and 2628.

[00198] The internally threaded connection 2612 of the end portion 2614 of the first tubular member 2610 is a box connection, and the externally threaded connection 2624 of the end portion 2626 of the second tubular member 2628 is a pin connection. In an exemplary embodiment, the internal diameter of the tubular sleeve 2616 is at least approximately .020" greater than the outside diameters of the first and second tubular members 2610 and 2628. In this manner, during the threaded coupling of the first and second tubular members 2610 and 2628, fluidic materials within the first and second tubular members may be vented from the tubular members.

[00199] As illustrated in Fig. 26, the first and second tubular members 2610 and 2628, and the tubular sleeve 2616 may then be positioned within another structure 2632 such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device 2634 through and/or within the interiors of the first and second tubular members. The tapered portions 2620 and 2622, of the tubular sleeve 2616 facilitates the insertion and movement of the first and second tubular members within and through the structure 2632, and the displacement of the expansion device 2634 through the interiors of the first and second tubular members 2610 and 2628, may, for example, be from top to bottom or from bottom to top.

[00200] During the radial expansion and plastic deformation of the first and second tubular members 2610 and 2628, the tubular sleeve 2616 is also radially expanded and plastically deformed. In an exemplary embodiment, as a result, the tubular sleeve 2616 may be maintained in circumferential tension and the end portions 2614 and 2626, of the first and second tubular members 2610 and 2628, may be maintained in circumferential compression.

[00201] Sleeve 2616 is covered by a thin walled cylinder of sacrificial material 2640. Spaces 2623 and 2624, adjacent tapered portions 2620 and 2622, respectively, are also filled with an excess of the sacrificial material 2640. The material may be a metal or a synthetic, and is provided to facilitate the insertion and movement of the first and second tubular members 2610 and 2628, through the structure 2632.

[00202] The addition of the sacrificial material 2640, provided on sleeve 2616, avoids stress risers on the sleeve 2616 and the tubular member 2610. The excess of the sacrificial material 2640 adjacent tapered portions 2620 and 2622 are intended to wear or even become damaged, thus incurring such wear or damage which would otherwise be borne by sleeve 2616. Sleeve 2616 may be secured to tubular members 2610 and 2628 by a heat shrink fit.

[00203] In several exemplary embodiments, one or more portions of the first and second tubular members, 2610 and 2628, and the tubular sleeve 2616 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00204] Referring to Fig. 27, in an exemplary embodiment, a first tubular member 2710 includes an internally threaded connection 2712 at an end portion 2714. A first end of a tubular sleeve 2716 includes an internal flange 2718 and a tapered portion 2720. A second end of the sleeve 2716 includes an internal flange 2721 and a tapered portion 2722. An externally threaded connection 2724 of an end portion 2726 of a second tubular member 2728 having an annular recess 2730, is then positioned within the tubular sleeve 2716 and threadably coupled to the internally threaded connection 2712 of the end portion 2714 of the first tubular member 2710. The internal flange 2718 of the sleeve 2716 mates with and is received within the annular recess 2730.

[00205] The first tubular member 2710 includes a recess 2731. The internal flange 2721 mates with and is received within the annular recess 2731. Thus, the sleeve 2716 is coupled to and surrounds the external surfaces of the first and second tubular members 2710 and 2728.

[00206] The internally threaded connection 2712 of the end portion 2714 of the first tubular member 2710 is a box connection, and the externally threaded connection 2724 of the end portion 2726 of the second tubular member 2728 is a pin connection. In an exemplary embodiment, the internal diameter of the tubular sleeve 2716 is at least approximately .020" greater than the outside diameters of the first and second tubular members 2710 and 2728. In this manner, during the threaded coupling of the first and second tubular members 2710 and 2728, fluidic materials within the first and second tubular members may be vented from the tubular members.

[00207] As illustrated in Fig. 27, the first and second tubular members 2710 and 2728, and the tubular sleeve 2716 may then be positioned within another structure 2732 such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device 2734 through and/or within the interiors of the first and second tubular members. The tapered portions 2720 and 2722, of the tubular sleeve 2716 facilitates the insertion and movement of the first and second tubular members

within and through the structure 2732, and the displacement of the expansion device 2734 through the interiors of the first and second tubular members 2710 and 2728, may be from top to bottom or from bottom to top.

[00208] During the radial expansion and plastic deformation of the first and second tubular members 2710 and 2728, the tubular sleeve 2716 is also radially expanded and plastically deformed. In an exemplary embodiment, as a result, the tubular sleeve 2716 may be maintained in circumferential tension and the end portions 2714 and 2726, of the first and second tubular members 2710 and 2728, may be maintained in circumferential compression.

[00209] Sleeve 2716 has a variable thickness due to one or more reduced thickness portions 2790 and/or increased thickness portions 2792.

[00210] Varying the thickness of sleeve 2716 provides the ability to control or induce stresses at selected positions along the length of sleeve 2716 and the end portions 2724 and 2726. Sleeve 2716 may be secured to tubular members 2710 and 2728 by a heat shrink fit.

[00211] In several exemplary embodiments, one or more portions of the first and second tubular members, 2710 and 2728, and the tubular sleeve 2716 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00212] Referring to Fig. 28, in an alternative embodiment, instead of varying the thickness of sleeve 2716, the same result described above with reference to Fig. 27, may be achieved by adding a member 2740 which may be coiled onto the grooves 2739 formed in sleeve 2716, thus varying the thickness along the length of sleeve 2716.

[00213] Referring to Fig. 29, in an exemplary embodiment, a first tubular member 2910 includes an internally threaded connection 2912 and an internal annular recess 2914 at an end portion 2916. A first end of a tubular sleeve 2918 includes an internal flange 2920, and a second end of the sleeve 2916 mates with and receives the end portion 2916 of the first tubular member 2910. An externally threaded connection 2922 of an end portion 2924 of a second tubular member 2926 having an annular recess 2928, is then positioned within the tubular sleeve 2918 and threadably coupled to the internally threaded connection 2912 of the end portion 2916 of the first tubular member 2910. The internal flange 2920 of the sleeve 2918 mates with and is received within the annular recess 2928. A sealing element 2930 is received within the internal annular recess 2914 of the end portion 2916 of the first tubular member 2910.

[00214] The internally threaded connection 2912 of the end portion 2916 of the first tubular member 2910 is a box connection, and the externally threaded connection 2922 of the end portion 2924 of the second tubular member 2926 is a pin connection. In an exemplary embodiment, the internal diameter of the tubular sleeve 2918 is at least

approximately .020" greater than the outside diameters of the first tubular member 2910. In this manner, during the threaded coupling of the first and second tubular members 2910 and 2926, fluidic materials within the first and second tubular members may be vented from the tubular members.

[00215] The first and second tubular members 2910 and 2926, and the tubular sleeve 2918 may be positioned within another structure such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device through and/or within the interiors of the first and second tubular members.

[00216] During the radial expansion and plastic deformation of the first and second tubular members 2910 and 2926, the tubular sleeve 2918 is also radially expanded and plastically deformed. In an exemplary embodiment, as a result, the tubular sleeve 2918 may be maintained in circumferential tension and the end portions 2916 and 2924, of the first and second tubular members 2910 and 2926, respectively, may be maintained in circumferential compression.

[00217] In an exemplary embodiment, before, during, and after the radial expansion and plastic deformation of the first and second tubular members 2910 and 2926, and the tubular sleeve 2918, the sealing element 2930 seals the interface between the first and second tubular members. In an exemplary embodiment, during and after the radial expansion and plastic deformation of the first and second tubular members 2910 and 2926, and the tubular sleeve 2918, a metal to metal seal is formed between at least one of: the first and second tubular members 2910 and 2926, the first tubular member and the tubular sleeve 2918, and/or the second tubular member and the tubular sleeve. In an exemplary embodiment, the metal to metal seal is both fluid tight and gas tight.

[00218] In several exemplary embodiments, one or more portions of the first and second tubular members, 2910 and 2926, the tubular sleeve 2918, and the sealing element 2930 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00219] Referring to Fig. 30a, in an exemplary embodiment, a first tubular member 3010 includes internally threaded connections 3012a and 3012b, spaced apart by a cylindrical internal surface 3014, at an end portion 3016. Externally threaded connections 3018a and 3018b, spaced apart by a cylindrical external surface 3020, of an end portion 3022 of a second tubular member 3024 are threadably coupled to the internally threaded connections, 3012a and 3012b, respectively, of the end portion 3016 of the first tubular member 3010. A sealing element 3026 is received within an annulus defined between the internal cylindrical surface 3014 of the first tubular member 3010 and the external cylindrical surface 3020 of the second tubular member 3024.

[00220] The internally threaded connections, 3012a and 3012b, of the end portion 3016 of the first tubular member 3010 are box connections, and the externally threaded connections, 3018a and 3018b, of the end portion 3022 of the second tubular member 3024 are pin connections. In an exemplary embodiment, the sealing element 3026 is an elastomeric and/or metallic sealing element.

[00221] The first and second tubular members 3010 and 3024 may be positioned within another structure such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device through and/or within the interiors of the first and second tubular members.

[00222] In an exemplary embodiment, before, during, and after the radial expansion and plastic deformation of the first and second tubular members 3010 and 3024, the sealing element 3026 seals the interface between the first and second tubular members. In an exemplary embodiment, before, during and/or after the radial expansion and plastic deformation of the first and second tubular members 3010 and 3024, a metal to metal seal is formed between at least one of: the first and second tubular members 3010 and 3024, the first tubular member and the sealing element 3026, and/or the second tubular member and the sealing element. In an exemplary embodiment, the metal to metal seal is both fluid tight and gas tight.

[00223] In an alternative embodiment, the sealing element 3026 is omitted, and during and/or after the radial expansion and plastic deformation of the first and second tubular members 3010 and 3024, a metal to metal seal is formed between the first and second tubular members.

[00224] In several exemplary embodiments, one or more portions of the first and second tubular members, 3010 and 3024, the sealing element 3026 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00225] Referring to Fig. 30b, in an exemplary embodiment, a first tubular member 3030 includes internally threaded connections 3032a and 3032b, spaced apart by an undulating approximately cylindrical internal surface 3034, at an end portion 3036. Externally threaded connections 3038a and 3038b, spaced apart by a cylindrical external surface 3040, of an end portion 3042 of a second tubular member 3044 are threadably coupled to the internally threaded connections, 3032a and 3032b, respectively, of the end portion 3036 of the first tubular member 3030. A sealing element 3046 is received within an annulus defined between the undulating approximately cylindrical internal surface 3034 of the first tubular member 3030 and the external cylindrical surface 3040 of the second tubular member 3044.

[00226] The internally threaded connections, 3032a and 3032b, of the end portion 3036 of the first tubular member 3030 are box connections, and the externally threaded connections, 3038a and 3038b, of the end portion 3042 of the second tubular member 3044 are pin connections. In an exemplary embodiment, the sealing element 3046 is an elastomeric and/or metallic sealing element.

[00227] The first and second tubular members 3030 and 3044 may be positioned within another structure such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device through and/or within the interiors of the first and second tubular members.

[00228] In an exemplary embodiment, before, during, and after the radial expansion and plastic deformation of the first and second tubular members 3030 and 3044, the sealing element 3046 seals the interface between the first and second tubular members. In an exemplary embodiment, before, during and/or after the radial expansion and plastic deformation of the first and second tubular members 3030 and 3044, a metal to metal seal is formed between at least one of: the first and second tubular members 3030 and 3044, the first tubular member and the sealing element 3046, and/or the second tubular member and the sealing element. In an exemplary embodiment, the metal to metal seal is both fluid tight and gas tight.

[00229] In an alternative embodiment, the sealing element 3046 is omitted, and during and/or after the radial expansion and plastic deformation of the first and second tubular members 3030 and 3044, a metal to metal seal is formed between the first and second tubular members.

[00230] In several exemplary embodiments, one or more portions of the first and second tubular members, 3030 and 3044, the sealing element 3046 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00231] Referring to Fig. 30c, in an exemplary embodiment, a first tubular member 3050 includes internally threaded connections 3052a and 3052b, spaced apart by a cylindrical internal surface 3054 including one or more square grooves 3056, at an end portion 3058. Externally threaded connections 3060a and 3060b, spaced apart by a cylindrical external surface 3062 including one or more square grooves 3064, of an end portion 3066 of a second tubular member 3068 are threadably coupled to the internally threaded connections, 3052a and 3052b, respectively, of the end portion 3058 of the first tubular member 3050. A sealing element 3070 is received within an annulus defined between the cylindrical internal surface 3054 of the first tubular member 3050 and the external cylindrical surface 3062 of the second tubular member 3068.

[00232] The internally threaded connections, 3052a and 3052b, of the end portion 3058 of the first tubular member 3050 are box connections, and the externally threaded connections, 3060a and 3060b, of the end portion 3066 of the second tubular member 3068 are pin connections. In an exemplary embodiment, the sealing element 3070 is an elastomeric and/or metallic sealing element.

[00233] The first and second tubular members 3050 and 3068 may be positioned within another structure such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device through and/or within the interiors of the first and second tubular members.

[00234] In an exemplary embodiment, before, during, and after the radial expansion and plastic deformation of the first and second tubular members 3050 and 3068, the sealing element 3070 seals the interface between the first and second tubular members. In an exemplary embodiment, before, during and/or after the radial expansion and plastic deformation of the first and second tubular members, 3050 and 3068, a metal to metal seal is formed between at least one of: the first and second tubular members, the first tubular member and the sealing element 3070, and/or the second tubular member and the sealing element. In an exemplary embodiment, the metal to metal seal is both fluid tight and gas tight.

[00235] In an alternative embodiment, the sealing element 3070 is omitted, and during and/or after the radial expansion and plastic deformation of the first and second tubular members 950 and 968, a metal to metal seal is formed between the first and second tubular members.

[00236] In several exemplary embodiments, one or more portions of the first and second tubular members, 3050 and 3068, the sealing element 3070 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00237] Referring to Fig. 31, in an exemplary embodiment, a first tubular member 3110 includes internally threaded connections, 3112a and 3112b, spaced apart by a non-threaded internal surface 3114, at an end portion 3116. Externally threaded connections, 3118a and 3118b, spaced apart by a non-threaded external surface 3120, of an end portion 3122 of a second tubular member 3124 are threadably coupled to the internally threaded connections, 3112a and 3112b, respectively, of the end portion 3122 of the first tubular member 3124.

[00238] First, second, and/or third tubular sleeves, 3126, 3128, and 3130, are coupled the external surface of the first tubular member 3110 in opposing relation to the threaded connection formed by the internal and external threads, 3112a and 3118a, the interface

between the non-threaded surfaces, 3114 and 3120, and the threaded connection formed by the internal and external threads, 3112b and 3118b, respectively.

[00239] The internally threaded connections, 3112a and 3112b, of the end portion 3116 of the first tubular member 3110 are box connections, and the externally threaded connections, 3118a and 3118b, of the end portion 3122 of the second tubular member 3124 are pin connections.

[00240] The first and second tubular members 3110 and 3124, and the tubular sleeves 3126, 3128, and/or 3130, may then be positioned within another structure 3132 such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device 3134 through and/or within the interiors of the first and second tubular members.

[00241] During the radial expansion and plastic deformation of the first and second tubular members 3110 and 3124, the tubular sleeves 3126, 3128 and/or 3130 are also radially expanded and plastically deformed. In an exemplary embodiment, as a result, the tubular sleeves 3126, 3128, and/or 3130 are maintained in circumferential tension and the end portions 3116 and 3122, of the first and second tubular members 3110 and 3124, may be maintained in circumferential compression.

[00242] The sleeves 3126, 3128, and/or 3130 may, for example, be secured to the first tubular member 3110 by a heat shrink fit.

[00243] In several exemplary embodiments, one or more portions of the first and second tubular members, 3110 and 3124, and the sleeves, 3126, 3128, and 3130, have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00244] Referring to Fig. 32a, in an exemplary embodiment, a first tubular member 3210 includes an internally threaded connection 3212 at an end portion 3214. An externally threaded connection 3216 of an end portion 3218 of a second tubular member 3220 are threadably coupled to the internally threaded connection 3212 of the end portion 3214 of the first tubular member 3210.

[00245] The internally threaded connection 3212 of the end portion 3214 of the first tubular member 3210 is a box connection, and the externally threaded connection 3216 of the end portion 3218 of the second tubular member 3220 is a pin connection.

[00246] A tubular sleeve 3222 including internal flanges 3224 and 3226 is positioned proximate and surrounding the end portion 3214 of the first tubular member 3210. As illustrated in Fig. 32b, the tubular sleeve 3222 is then forced into engagement with the external surface of the end portion 3214 of the first tubular member 3210 in a conventional manner. As a result, the end portions, 3214 and 3218, of the first and second tubular members, 3210 and 3220, are upset in an undulating fashion.

[00247] The first and second tubular members 3210 and 3220, and the tubular sleeve 3222, may then be positioned within another structure such as, for example, a wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating an expansion device through and/or within the interiors of the first and second tubular members.

[00248] During the radial expansion and plastic deformation of the first and second tubular members 3210 and 3220, the tubular sleeve 3222 is also radially expanded and plastically deformed. In an exemplary embodiment, as a result, the tubular sleeve 3222 is maintained in circumferential tension and the end portions 3214 and 3218, of the first and second tubular members 3210 and 3220, may be maintained in circumferential compression.

[00249] In several exemplary embodiments, one or more portions of the first and second tubular members, 3210 and 3220, and the sleeve 3222 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00250] Referring to Fig. 33, in an exemplary embodiment, a first tubular member 3310 includes an internally threaded connection 3312 and an annular projection 3314 at an end portion 3316.

[00251] A first end of a tubular sleeve 3318 that includes an internal flange 3320 having a tapered portion 3322 and an annular recess 3324 for receiving the annular projection 3314 of the first tubular member 3310, and a second end that includes a tapered portion 3326, is then mounted upon and receives the end portion 3316 of the first tubular member 3310.

[00252] In an exemplary embodiment, the end portion 3316 of the first tubular member 3310 abuts one side of the internal flange 3320 of the tubular sleeve 3318 and the annular projection 3314 of the end portion of the first tubular member mates with and is received within the annular recess 3324 of the internal flange of the tubular sleeve, and the internal diameter of the internal flange 3320 of the tubular sleeve 3318 is substantially equal to or greater than the maximum internal diameter of the internally threaded connection 3312 of the end portion 3316 of the first tubular member 3310. An externally threaded connection 3326 of an end portion 3328 of a second tubular member 3330 having an annular recess 3332 is then positioned within the tubular sleeve 3318 and threadably coupled to the internally threaded connection 3312 of the end portion 3316 of the first tubular member 3310. In an exemplary embodiment, the internal flange 3332 of the tubular sleeve 3318 mates with and is received within the annular recess 3332 of the end portion 3328 of the second tubular member 3330. Thus, the tubular sleeve 3318 is coupled to and surrounds the external surfaces of the first and second tubular members, 3310 and 3328.

[00253] The internally threaded connection 3312 of the end portion 3316 of the first tubular member 3310 is a box connection, and the externally threaded connection 3326 of

the end portion 3328 of the second tubular member 3330 is a pin connection. In an exemplary embodiment, the internal diameter of the tubular sleeve 3318 is at least approximately .020" greater than the outside diameters of the first and second tubular members, 3310 and 3330. In this manner, during the threaded coupling of the first and second tubular members, 3310 and 3330, fluidic materials within the first and second tubular members may be vented from the tubular members.

[00254] As illustrated in Fig. 33, the first and second tubular members, 3310 and 3330, and the tubular sleeve 3318 may be positioned within another structure 3334 such as, for example, a cased or uncased wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating a conventional expansion device 3336 within and/or through the interiors of the first and second tubular members. The tapered portions, 3322 and 3326, of the tubular sleeve 3318 facilitate the insertion and movement of the first and second tubular members within and through the structure 3334, and the movement of the expansion device 3336 through the interiors of the first and second tubular members, 3310 and 3330, may, for example, be from top to bottom or from bottom to top.

[00255] During the radial expansion and plastic deformation of the first and second tubular members, 3310 and 3330, the tubular sleeve 3318 is also radially expanded and plastically deformed. As a result, the tubular sleeve 3318 may be maintained in circumferential tension and the end portions, 3316 and 3328, of the first and second tubular members, 3310 and 3330, may be maintained in circumferential compression.

[00256] Sleeve 3316 increases the axial compression loading of the connection between tubular members 3310 and 3330 before and after expansion by the expansion device 3336. Sleeve 3316 may be secured to tubular members 3310 and 3330, for example, by a heat shrink fit.

[00257] In several alternative embodiments, the first and second tubular members, 3310 and 3330, are radially expanded and plastically deformed using other conventional methods for radially expanding and plastically deforming tubular members such as, for example, internal pressurization, hydroforming, and/or roller expansion devices and/or any one or combination of the conventional commercially available expansion products and services available from Baker Hughes, Weatherford International, and/or Enventure Global Technology L.L.C.

[00258] The use of the tubular sleeve 3318 during (a) the coupling of the first tubular member 3310 to the second tubular member 3330, (b) the placement of the first and second tubular members in the structure 3334, and (c) the radial expansion and plastic deformation of the first and second tubular members provides a number of significant benefits. For example, the tubular sleeve 3318 protects the exterior surfaces of the end portions, 3316 and 3328, of the first and second tubular members, 3310 and 3330, during handling and

insertion of the tubular members within the structure 3334. In this manner, damage to the exterior surfaces of the end portions, 3316 and 3328, of the first and second tubular members, 3310 and 3330, is avoided that could otherwise result in stress concentrations that could cause a catastrophic failure during subsequent radial expansion operations. Furthermore, the tubular sleeve 3318 provides an alignment guide that facilitates the insertion and threaded coupling of the second tubular member 3330 to the first tubular member 3310. In this manner, misalignment that could result in damage to the threaded connections, 3312 and 3326, of the first and second tubular members, 3310 and 3330, may be avoided. In addition, during the relative rotation of the second tubular member with respect to the first tubular member, required during the threaded coupling of the first and second tubular members, the tubular sleeve 3318 provides an indication of to what degree the first and second tubular members are threadably coupled. For example, if the tubular sleeve 3318 can be easily rotated, that would indicate that the first and second tubular members, 3310 and 3330, are not fully threadably coupled and in intimate contact with the internal flange 3320 of the tubular sleeve. Furthermore, the tubular sleeve 3318 may prevent crack propagation during the radial expansion and plastic deformation of the first and second tubular members, 3310 and 3330. In this manner, failure modes such as, for example, longitudinal cracks in the end portions, 3316 and 3328, of the first and second tubular members may be limited in severity or eliminated all together. In addition, after completing the radial expansion and plastic deformation of the first and second tubular members, 3310 and 3330, the tubular sleeve 3318 may provide a fluid tight metal-to-metal seal between interior surface of the tubular sleeve 3318 and the exterior surfaces of the end portions, 3316 and 3328, of the first and second tubular members. In this manner, fluidic materials are prevented from passing through the threaded connections, 3312 and 3326, of the first and second tubular members, 3310 and 3330, into the annulus between the first and second tubular members and the structure 3334. Furthermore, because, following the radial expansion and plastic deformation of the first and second tubular members, 3310 and 3330, the tubular sleeve 3318 may be maintained in circumferential tension and the end portions, 3316 and 3328, of the first and second tubular members, 3310 and 3330, may be maintained in circumferential compression, axial loads and/or torque loads may be transmitted through the tubular sleeve.

[00259] In several exemplary embodiments, one or more portions of the first and second tubular members, 3310 and 3330, and the sleeve 3318 have one or more of the material properties of one or more of the tubular members 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204.

[00260] Referring to Figs. 34a, 34b, and 34c, in an exemplary embodiment, a first tubular member 3410 includes an internally threaded connection 1312 and one or more

external grooves 3414 at an end portion 3416.

[00261] A first end of a tubular sleeve 3418 that includes an internal flange 3420 and a tapered portion 3422, a second end that includes a tapered portion 3424, and an intermediate portion that includes one or more longitudinally aligned openings 3426, is then mounted upon and receives the end portion 3416 of the first tubular member 3410.

[00262] In an exemplary embodiment, the end portion 3416 of the first tubular member 3410 abuts one side of the internal flange 3420 of the tubular sleeve 3418, and the internal diameter of the internal flange 3420 of the tubular sleeve 3416 is substantially equal to or greater than the maximum internal diameter of the internally threaded connection 3412 of the end portion 3416 of the first tubular member 3410. An externally threaded connection 3428 of an end portion 3430 of a second tubular member 3432 that includes one or more internal grooves 3434 is then positioned within the tubular sleeve 3418 and threadably coupled to the internally threaded connection 3412 of the end portion 3416 of the first tubular member 3410. In an exemplary embodiment, the internal flange 3420 of the tubular sleeve 3418 mates with and is received within an annular recess 3436 defined in the end portion 3430 of the second tubular member 3432. Thus, the tubular sleeve 3418 is coupled to and surrounds the external surfaces of the first and second tubular members, 3410 and 3432.

[00263] The first and second tubular members, 3410 and 3432, and the tubular sleeve 3418 may be positioned within another structure such as, for example, a cased or uncased wellbore, and radially expanded and plastically deformed, for example, by displacing and/or rotating a conventional expansion device within and/or through the interiors of the first and second tubular members. The tapered portions, 3422 and 3424, of the tubular sleeve 3418 facilitate the insertion and movement of the first and second tubular members within and through the structure, and the movement of the expansion device through the interiors of the first and second tubular members, 3410 and 3432, may be from top to bottom or from bottom to top.

[00264] During the radial expansion and plastic deformation of the first and second tubular members, 3410 and 3432, the tubular sleeve 3418 is also radially expanded and plastically deformed. As a result, the tubular sleeve 3418 may be maintained in circumferential tension and the end portions, 3416 and 3430, of the first and second tubular members, 3410 and 3432, may be maintained in circumferential compression.

[00265] Sleeve 3416 increases the axial compression loading of the connection between tubular members 3410 and 3432 before and after expansion by the expansion device. The sleeve 3418 may be secured to tubular members 3410 and 3432, for example, by a heat shrink fit.

[00266] During the radial expansion and plastic deformation of the first and second tubular members, 3410 and 3432, the grooves 3414 and/or 3434 and/or the openings 3426

provide stress concentrations that in turn apply added stress forces to the mating threads of the threaded connections, 3412 and 3428. As a result, during and after the radial expansion and plastic deformation of the first and second tubular members, 3410 and 3432, the mating threads of the threaded connections, 3412 and 3428, are maintained in metal to metal contact thereby providing a fluid and gas tight connection. In an exemplary embodiment, the orientations of the grooves 3414 and/or 3434 and the openings 3426 are orthogonal to one another. In an exemplary embodiment, the grooves 3414 and/or 3434 are helical grooves.

[00267] In several alternative embodiments, the first and second tubular members, 3410 and 3432, are radially expanded and plastically deformed using other conventional methods for radially expanding and plastically deforming tubular members such as, for example, internal pressurization, hydroforming, and/or roller expansion devices and/or any one or combination of the conventional commercially available expansion products and services available from Baker Hughes, Weatherford International, and/or Enventure Global Technology L.L.C.

[00268] The use of the tubular sleeve 3418 during (a) the coupling of the first tubular member 3410 to the second tubular member 3432, (b) the placement of the first and second tubular members in the structure, and (c) the radial expansion and plastic deformation of the first and second tubular members provides a number of significant benefits. For example, the tubular sleeve 3418 protects the exterior surfaces of the end portions, 3416 and 3430, of the first and second tubular members, 3410 and 3432, during handling and insertion of the tubular members within the structure. In this manner, damage to the exterior surfaces of the end portions, 3416 and 3430, of the first and second tubular members, 3410 and 3432, is avoided that could otherwise result in stress concentrations that could cause a catastrophic failure during subsequent radial expansion operations. Furthermore, the tubular sleeve 3418 provides an alignment guide that facilitates the insertion and threaded coupling of the second tubular member 3432 to the first tubular member 3410. In this manner, misalignment that could result in damage to the threaded connections, 3412 and 3428, of the first and second tubular members, 3410 and 3432, may be avoided. In addition, during the relative rotation of the second tubular member with respect to the first tubular member, required during the threaded coupling of the first and second tubular members, the tubular sleeve 3416 provides an indication of to what degree the first and second tubular members are threadably coupled. For example, if the tubular sleeve 3418 can be easily rotated, that would indicate that the first and second tubular members, 3410 and 3432, are not fully threadably coupled and in intimate contact with the internal flange 3420 of the tubular sleeve. Furthermore, the tubular sleeve 3418 may prevent crack propagation during the radial expansion and plastic deformation of the first and second tubular members, 3410 and 3432. In this manner, failure modes such as, for example, longitudinal cracks in the end

portions, 3416 and 3430, of the first and second tubular members may be limited in severity or eliminated all together. In addition, after completing the radial expansion and plastic deformation of the first and second tubular members, 3410 and 3432, the tubular sleeve 3418 may provide a fluid and gas tight metal-to-metal seal between interior surface of the tubular sleeve 3418 and the exterior surfaces of the end portions, 3416 and 3430, of the first and second tubular members. In this manner, fluidic materials are prevented from passing through the threaded connections, 3412 and 3430, of the first and second tubular members, 3410 and 3432, into the annulus between the first and second tubular members and the structure. Furthermore, because, following the radial expansion and plastic deformation of the first and second tubular members, 3410 and 3432, the tubular sleeve 3418 may be maintained in circumferential tension and the end portions, 3416 and 3430, of the first and second tubular members, 3410 and 3432, may be maintained in circumferential compression, axial loads and/or torque loads may be transmitted through the tubular sleeve.

[00269] In several exemplary embodiments, the first and second tubular members described above with reference to Figs. 1 to 34c are radially expanded and plastically deformed using the expansion device in a conventional manner and/or using one or more of the methods and apparatus disclosed in one or more of the following: The present application is related to the following: (1) U.S. patent application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, (2) U.S. patent application serial no. 09/510,913, attorney docket no. 25791.7.02, filed on 2/23/2000, (3) U.S. patent application serial no. 09/502,350, attorney docket no. 25791.8.02, filed on 2/10/2000, (4) U.S. patent application serial no. 09/440,338, attorney docket no. 25791.9.02, filed on 11/15/1999, (5) U.S. patent application serial no. 09/523,460, attorney docket no. 25791.11.02, filed on 3/10/2000, (6) U.S. patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, (7) U.S. patent application serial no. 09/511,941, attorney docket no. 25791.16.02, filed on 2/24/2000, (8) U.S. patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, (9) U.S. patent application serial no. 09/559,122, attorney docket no. 25791.23.02, filed on 4/26/2000, (10) PCT patent application serial no. PCT/US00/18635, attorney docket no. 25791.25.02, filed on 7/9/2000, (11) U.S. provisional patent application serial no. 60/162,671, attorney docket no. 25791.27, filed on 11/1/1999, (12) U.S. provisional patent application serial no. 60/154,047, attorney docket no. 25791.29, filed on 9/16/1999, (13) U.S. provisional patent application serial no. 60/159,082, attorney docket no. 25791.34, filed on 10/12/1999, (14) U.S. provisional patent application serial no. 60/159,039, attorney docket no. 25791.36, filed on 10/12/1999, (15) U.S. provisional patent application serial no. 60/159,033, attorney docket no. 25791.37, filed on 10/12/1999, (16) U.S. provisional patent application serial no. 60/212,359, attorney docket no. 25791.38, filed on 6/19/2000, (17) U.S. provisional patent application serial no.

60/165,228, attorney docket no. 25791.39, filed on 11/12/1999, (18) U.S. provisional patent application serial no. 60/221,443, attorney docket no. 25791.45, filed on 7/28/2000, (19) U.S. provisional patent application serial no. 60/221,645, attorney docket no. 25791.46, filed on 7/28/2000, (20) U.S. provisional patent application serial no. 60/233,638, attorney docket no. 25791.47, filed on 9/18/2000, (21) U.S. provisional patent application serial no. 60/237,334, attorney docket no. 25791.48, filed on 10/2/2000, (22) U.S. provisional patent application serial no. 60/270,007, attorney docket no. 25791.50, filed on 2/20/2001, (23) U.S. provisional patent application serial no. 60/262,434, attorney docket no. 25791.51, filed on 1/17/2001, (24) U.S, provisional patent application serial no. 60/259,486, attorney docket no. 25791.52, filed on 1/3/2001, (25) U.S. provisional patent application serial no. 60/303,740, attorney docket no. 25791.61, filed on 7/6/2001, (26) U.S. provisional patent application serial no. 60/313,453, attorney docket no. 25791.59, filed on 8/20/2001, (27) U.S. provisional patent application serial no. 60/317,985, attorney docket no. 25791.67, filed on 9/6/2001, (28) U.S. provisional patent application serial no. 60/3318,386, attorney docket no. 25791.67.02, filed on 9/10/2001, (29) U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, (30) U.S. utility patent application serial no. 10/016,467, attorney docket no. 25791.70, filed on December 10, 2001, (31) U.S. provisional patent application serial no. 60/343,674, attorney docket no. 25791.68, filed on 12/27/2001; and (32) U.S. provisional patent application serial no. 60/346,309, attorney docket no. 25791.92, filed on 01/07/02, the disclosures of which are incorporated herein by reference.

[00270] Referring to Fig. 35a an exemplary embodiment of an expandable tubular member 3500 includes a first tubular region 3502 and a second tubular portion 3504. In an exemplary embodiment, the material properties of the first and second tubular regions, 3502 and 3504, are different. In an exemplary embodiment, the yield points of the first and second tubular regions, 3502 and 3504, are different. In an exemplary embodiment, the yield point of the first tubular region 3502 is less than the yield point of the second tubular region 3504. In several exemplary embodiments, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202 and/or 204 incorporate the tubular member 3500.

[00271] Referring to Fig. 35b, in an exemplary embodiment, the yield point within the first and second tubular regions, 3502a and 3502b, of the expandable tubular member 3502 vary as a function of the radial position within the expandable tubular member. In an exemplary embodiment, the yield point increases as a function of the radial position within the expandable tubular member 3502. In an exemplary embodiment, the relationship between the yield point and the radial position within the expandable tubular member 3502 is a linear relationship. In an exemplary embodiment, the relationship between the yield point and the radial position within the expandable tubular member 3502 is a non-linear

relationship. In an exemplary embodiment, the yield point increases at different rates within the first and second tubular regions, 3502a and 3502b, as a function of the radial position within the expandable tubular member 3502. In an exemplary embodiment, the functional relationship, and value, of the yield points within the first and second tubular regions, 3502a and 3502b, of the expandable tubular member 3502 are modified by the radial expansion and plastic deformation of the expandable tubular member.

[00272] In several exemplary embodiments, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202, 204 and/or 3502, prior to a radial expansion and plastic deformation, include a microstructure that is a combination of a hard phase, such as martensite, a soft phase, such as ferrite, and a transitionary phase, such as retained austentite. In this manner, the hard phase provides high strength, the soft phase provides ductility, and the transitionary phase transitions to a hard phase, such as martensite, during a radial expansion and plastic deformation. Furthermore, in this manner, the yield point of the tubular member increases as a result of the radial expansion and plastic deformation. Further, in this manner, the tubular member is ductile, prior to the radial expansion and plastic deformation, thereby facilitating the radial expansion and plastic deformation. In an exemplary embodiment, the composition of a dual-phase expandable tubular member includes (weight percentages): about 0.1% C, 1.2% Mn, and 0.3% Si.

[00273] In an exemplary experimental embodiment, as illustrated in Figs. 36a-36c, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202, 204 and/or 3502 are processed in accordance with a method 3600, in which, in step 3602, an expandable tubular member 3602a is provided that is a steel alloy having following material composition (by weight percentage): 0.065% C, 1.44% Mn, 0.01% P, 0.002% S, 0.24% Si, 0.01% Cu, 0.01% Ni, 0.02% Cr, 0.05% V, 0.01%Mo, 0.01% Nb, and 0.01% Ti. In an exemplary experimental embodiment, the expandable tubular member 3602a provided in step 3602 has a yield strength of 45 ksi, and a tensile strength of 69 ksi.

[00274] In an exemplary experimental embodiment, as illustrated in Fig. 36b, in step 3602, the expandable tubular member 3602a includes a microstructure that includes martensite, pearlite, and V, Ni, and/or Ti carbides.

[00275] In an exemplary embodiment, the expandable tubular member 3602a is then heated at a temperature of 790 °C for about 10 minutes in step 3604.

[00276] In an exemplary embodiment, the expandable tubular member 3602a is then quenched in water in step 3606.

[00277] In an exemplary experimental embodiment, as illustrated in Fig. 36c, following the completion of step 3606, the expandable tubular member 3602a includes a microstructure that includes new ferrite, grain pearlite, martensite, and ferrite. In an

exemplary experimental embodiment, following the completion of step 3606, the expandable tubular member 3602a has a yield strength of 67 ksi, and a tensile strength of 95 ksi.

[00278] In an exemplary embodiment, the expandable tubular member 3602a is then radially expanded and plastically deformed using one or more of the methods and apparatus described above. In an exemplary embodiment, following the radial expansion and plastic deformation of the expandable tubular member 3602a, the yield strength of the expandable tubular member is about 95 ksi.

[00279] In an exemplary experimental embodiment, as illustrated in Figs. 37a-37c, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202, 204 and/or 3502 are processed in accordance with a method 3700, in which, in step 3702, an expandable tubular member 3702a is provided that is a steel alloy having following material composition (by weight percentage): 0.18% C, 1.28% Mn, 0.017% P, 0.004% S, 0.29% Si, 0.01% Cu, 0.01% Ni, 0.03% Cr, 0.04% V, 0.01%Mo, 0.03% Nb, and 0.01% Ti. In an exemplary experimental embodiment, the expandable tubular member 3702a provided in step 3702 has a yield strength of 60 ksi, and a tensile strength of 80 ksi.

[00280] In an exemplary experimental embodiment, as illustrated in Fig. 37b, in step 3702, the expandable tubular member 3702a includes a microstructure that includes pearlite and pearlite striation.

[00281] In an exemplary embodiment, the expandable tubular member 3702a is then heated at a temperature of 790 °C for about 10 minutes in step 3704.

[00282] In an exemplary embodiment, the expandable tubular member 3702a is then quenched in water in step 3706.

[00283] In an exemplary experimental embodiment, as illustrated in Fig. 37c, following the completion of step 3706, the expandable tubular member 3702a includes a microstructure that includes ferrite, martensite, and bainite. In an exemplary experimental embodiment, following the completion of step 3706, the expandable tubular member 3702a has a yield strength of 82 ksi, and a tensile strength of 130 ksi.

[00284] In an exemplary embodiment, the expandable tubular member 3702a is then radially expanded and plastically deformed using one or more of the methods and apparatus described above. In an exemplary embodiment, following the radial expansion and plastic deformation of the expandable tubular member 3702a, the yield strength of the expandable tubular member is about 130 ksi.

[00285] In an exemplary experimental embodiment, as illustrated in Figs. 38a-38c, one or more of the expandable tubular members, 12, 14, 24, 26, 102, 104, 106, 108, 202, 204 and/or 3502 are processed in accordance with a method 3800, in which, in step 3802, an expandable tubular member 3802a is provided that is a steel alloy having following material composition (by weight percentage): 0.08% C, 0.82% Mn, 0.006% P, 0.003% S,

0.30% Si, 0.06% Cu, 0.05% Ni, 0.05% Cr, 0.03% V, 0.03%Mo, 0.01% Nb, and 0.01% Ti. In an exemplary experimental embodiment, the expandable tubular member 3802a provided in step 3802 has a yield strength of 56 ksi, and a tensile strength of 75 ksi.

[00286] In an exemplary experimental embodiment, as illustrated in Fig. 38b, in step 3802, the expandable tubular member 3802a includes a microstructure that includes grain pearlite, widmanstatten martensite and carbides of V, Ni, and/or Ti.

[00287] In an exemplary embodiment, the expandable tubular member 3802a is then heated at a temperature of 790 °C for about 10 minutes in step 3804.

[00288] In an exemplary embodiment, the expandable tubular member 3802a is then quenched in water in step 3806.

[00289] In an exemplary experimental embodiment, as illustrated in Fig. 38c, following the completion of step 3806, the expandable tubular member 3802a includes a microstructure that includes bainite, pearlite, and new ferrite. In an exemplary experimental embodiment, following the completion of step 3806, the expandable tubular member 3802a has a yield strength of 60 ksi, and a tensile strength of 97 ksi.

[00290] In an exemplary embodiment, the expandable tubular member 3802a is then radially expanded and plastically deformed using one or more of the methods and apparatus described above. In an exemplary embodiment, following the radial expansion and plastic deformation of the expandable tubular member 3802a, the yield strength of the expandable tubular member is about 97 ksi.

[00291] In several exemplary embodiments, the teachings of the present disclosure are combined with one or more of the teachings disclosed in FR 2 841 626, filed on 6/28/2002, and published on 1/2/2004, the disclosure of which is incorporated herein by reference.

[00292] Referring to Figs. 39a-39f, an exemplary embodiment of an expansion system 3900 includes an adjustable expansion device 3902 and a hydroforming expansion device 3904 that are both coupled to a support member 3906.

[00293] In several exemplary embodiments, the adjustable expansion device 3902 includes one or more elements of conventional adjustable expansion devices and/or one or more elements of the adjustable expansion devices disclosed in one or more of the related applications referenced above and/or one or more elements of the conventional commercially available adjustable expansion devices available from Baker Hughes, Weatherford International, Schlumberger, and/or Enventure Global Technology L.L.C. In several exemplary embodiments, the hydroforming expansion device 3904 includes one or more elements of conventional hydroforming expansion devices and/or one or more elements of the hydroforming expansion devices disclosed in one or more of the related applications referenced above and/or one or more elements of the conventional

commercially available hydroforming devices available from Baker Hughes, Weatherford International, Schlumberger, and/or Enventure Global Technology L.L.C. and/or one or more elements of the hydroforming expansion devices disclosed in U.S. Patent No. 5,901,594, the disclosure of which is incorporated herein by reference. In several exemplary embodiments, the adjustable expansion device 3902 and the hydroforming expansion device 3904 may be combined in a single device and/or include one or more elements of each other.

[00294] In an exemplary embodiment, during the operation of the expansion system 3900, as illustrated in Figs. 39a and 39b, the expansion system is positioned within an expandable tubular assembly that includes first and second tubular members, 3908 and 3910, that are coupled end to end and positioned and supported within a preexisting structure such as, for example, a wellbore 3912 that traverses a subterranean formation 3914. In several exemplary embodiments, the first and second tubular members, 3908 and 3910, include one or more of the characteristics of the expandable tubular members described in the present application.

[00295] In an exemplary embodiment, as illustrated in Fig. 39c, the hydroforming expansion device 3904 may then be operated to radially expand and plastically deform a portion of the second tubular member 3910.

[00296] In an exemplary embodiment, as illustrated in Fig. 39d, the hydroforming expansion device 3904 may then be disengaged from the second tubular member 3910.

[00297] In an exemplary embodiment, as illustrated in Fig. 39e, the adjustable expansion device 3902 may then be positioned within the radially expanded portion of the second tubular member 3910 and the size the adjustable expansion device increased.

[00298] In an exemplary embodiment, as illustrated in Fig. 39f, the adjustable expansion device 3902 may then be operated to radially expand and plastically deform one or more portions of the first and second tubular members, 3908 and 3910.

[00299] Referring to Figs. 40a-40g, an exemplary embodiment of an expansion system 4000 includes a hydroforming expansion device 4002 that is coupled to a support member 4004.

[00300] In several exemplary embodiments, the hydroforming expansion device 4002 includes one or more elements of conventional hydroforming expansion devices and/or one or more elements of the hydroforming expansion devices disclosed in one or more of the related applications referenced above and/or one or more elements of the conventional commercially available hydroforming devices available from Baker Hughes, Weatherford International, Schlumberger, and/or Enventure Global Technology L.L.C. and/or one or more elements of the hydroforming expansion devices disclosed in U.S. Patent No. 5,901,594, the disclosure of which is incorporated herein by reference.

[00301] In an exemplary embodiment, during the operation of the expansion system 4000, as illustrated in Figs. 40a and 40b, the expansion system is positioned within an expandable tubular assembly that includes first and second tubular members, 4006 and 4008, that are coupled end to end and positioned and supported within a preexisting structure such as, for example, a wellbore 4010 that traverses a subterranean formation 4012. In several exemplary embodiments, the first and second tubular members, 4004 and 4006, include one or more of the characteristics of the expandable tubular members described in the present application.

[00302] In an exemplary embodiment, as illustrated in Figs. 40c to 40f, the hydroforming expansion device 4002 may then be repeatedly operated to radially expand and plastically deform one or more portions of the first and second tubular members, 4008 and 4010.

[00303] Referring to Figs. 41a-41h, an exemplary embodiment of an expansion system 4100 includes an adjustable expansion device 4102 and a hydroforming expansion device 4104 that are both coupled to a tubular support member 4106.

[00304] In several exemplary embodiments, the adjustable expansion device 4102 includes one or more elements of conventional adjustable expansion devices and/or one or more elements of the adjustable expansion devices disclosed in one or more of the related applications referenced above and/or one or more elements of the conventional commercially available adjustable expansion devices available from Baker Hughes, Weatherford International, Schlumberger, and/or Enventure Global Technology L.L.C. In several exemplary embodiments, the hydroforming expansion device 4104 includes one or more elements of conventional hydroforming expansion devices and/or one or more elements of the hydroforming expansion devices disclosed in one or more of the related applications referenced above and/or one or more elements of the conventional commercially available hydroforming devices available from Baker Hughes, Weatherford International, Schlumberger, and/or Enventure Global Technology L.L.C. and/or one or more elements of the hydroforming expansion devices disclosed in U.S. Patent No. 5,901,594, the disclosure of which is incorporated herein by reference. In several exemplary embodiments, the adjustable expansion device 4102 and the hydroforming expansion device 4104 may be combined in a single device and/or include one or more elements of each other.

[00305] In an exemplary embodiment, during the operation of the expansion system 4100, as illustrated in Figs. 41a and 41b, the expansion system is positioned within an expandable tubular assembly that includes first and second tubular members, 4108 and 4110, that are coupled end to end and positioned and supported within a preexisting structure such as, for example, a wellbore 4112 that traverses a subterranean formation 4114. In an exemplary embodiment, a shoe 4116 having a valveable passage 4118 is

coupled to the lower portion of the second tubular member 4110. In several exemplary embodiments, the first and second tubular members, 4108 and 4110, include one or more of the characteristics of the expandable tubular members described in the present application.

[00306] In an exemplary embodiment, as illustrated in Fig. 41c, the hydroforming expansion device 4104 may then be operated to radially expand and plastically deform a portion of the second tubular member 4110.

[00307] In an exemplary embodiment, as illustrated in Fig. 41d, the hydroforming expansion device 4104 may then be disengaged from the second tubular member 4110.

[00308] In an exemplary embodiment, as illustrated in Figs. 41e and 41f, the adjustable expansion device 4102 may then be positioned within the radially expanded portion of the second tubular member 4110 and the size the adjustable expansion device increased. The valveable passage 4118 of the shoe 4116 may then be closed, for example, by placing a ball 4120 within the passage in a conventional manner.

[00309] In an exemplary embodiment, as illustrated in Fig. 41g, the adjustable expansion device 4102 may then be operated to radially expand and plastically deform one or more portions of the first and second tubular members, 4108 and 4110, above the shoe 4116.

[00310] In an exemplary embodiment, as illustrated in Fig. 41h, the expansion system 4100 may then be removed from the tubular assembly and the lower, radially unexpanded, portion of the second tubular member 4110 and the shoe 4116 may be machined away.

[00311] Referring to Figs. 42a-42e, an exemplary embodiment of an expansion system 4200 includes a hydroforming expansion device 4202 that is coupled to a tubular support member 4204. An expandable tubular member 4206 is coupled to and supported by the hydroforming expansion device 4202.

[00312] In several exemplary embodiments, the hydroforming expansion device 4202 includes one or more elements of conventional hydroforming expansion devices and/or one or more elements of the hydroforming expansion devices disclosed in one or more of the related applications referenced above and/or one or more elements of the conventional commercially available hydroforming devices available from Baker Hughes, Weatherford International, Schlumberger, and/or Enventure Global Technology L.L.C. and/or one or more elements of the hydroforming expansion devices disclosed in U.S. Patent No. 5,901,594, the disclosure of which is incorporated herein by reference.

[00313] In several exemplary embodiments, the expandable tubular member 4206 includes one or more of the characteristics of the expandable tubular members described in the present application.

[00314] In an exemplary embodiment, during the operation of the expansion system 4200, as illustrated in Figs. 42a and 42b, the expansion system is positioned within an

expandable tubular assembly that includes first and second tubular members, 4208 and 4210, that are coupled end to end and positioned and supported within a preexisting structure such as, for example, a wellbore 4212 that traverses a subterranean formation 4214. In an exemplary embodiment, the second tubular member 4210 includes one or more radial passages 4212. In an exemplary embodiment, the expandable tubular member 4206 is positioned in opposing relation to the radial passages 4212 of the second tubular member 4210.

[00315] In an exemplary embodiment, as illustrated in Fig. 42c, the hydroforming expansion device 4202 may then be operated to radially expand and plastically deform the expandable tubular member 4206 into contact with the interior surface of the second tubular member 4210 thereby covering and sealing off the radial passages 4212 of the second tubular member.

[00316] In an exemplary embodiment, as illustrated in Fig. 42d, the hydroforming expansion device 4202 may then be disengaged from the expandable tubular member 4206.

[00317] In an exemplary embodiment, as illustrated in Figs. 42e, the expansion system 4200 may then be removed from the wellbore 4212.

[00318] Referring to Fig. 43, an exemplary embodiment of a hydroforming expansion system 4300 includes an expansion element 4302 that is provided substantially as disclosed in U.S. Patent No. 5,901,594, the disclosure of which is incorporated herein by reference.

[00319] A flow line 4304 is coupled to the inlet of the expansion element 4302 and the outlet of conventional 2-way/2-position flow control valve 4306. A flow line 4308 is coupled to an inlet of the flow control valve 4306 and an outlet of a conventional accumulator 4310, and a flow line 4312 is coupled to another inlet of the flow control valve and a fluid reservoir 4314.

[00320] A flow line 4316 is coupled to the flow line 4308 and an the inlet of a conventional pressure relief valve 4318, and a flow line 4320 is coupled to the outlet of the pressure relief valve and the fluid reservoir 4314. A flow line 4322 is coupled to the inlet of the accumulator 4310 and the outlet of a conventional check valve 4324.

[00321] A flow line 4326 is coupled to the inlet of the check valve 4324 and the outlet of a conventional pump 4328. A flow line 4330 is coupled to the flow line 4326 and the inlet of a conventional pressure relief valve 4332.

[00322] A flow line 4334 is coupled to the outlet of the pressure relief valve 4332 and the fluid reservoir 4314, and a flow line 4336 is coupled to the inlet of the pump 4328 and the fluid reservoir.

[00323] A controller 4338 is operably coupled to the flow control valve 4306 and the pump 4328 for controlling the operation of the flow control valve and the pump. In an exemplary embodiment, the controller 4338 is a programmable general purpose controller.

Conventional pressure sensors, 4340, 4342 and 4344, are operably coupled to the expansion element 4302, the accumulator 4310, and the flow line 4326, respectively, and the controller 4338. A conventional user interface 4346 is operably coupled to the controller 4338.

[00324] During operation of the hydroforming expansion system 4300, as illustrated in Figs. 44a-44b, the system implements a method of operation 4400 in which, in step 4402, the user may select expansion of an expandable tubular member. If the user selects expansion in step 4402, then the controller 4338 determines if the operating pressure of the accumulator 4310, as sensed by the pressure sensor 4342, is greater than or equal to a predetermined value in step 4404.

[00325] If the operating pressure of the accumulator 4310, as sensed by the pressure sensor 4342, is not greater than or equal to the predetermined value in step 4404, then the controller 4338 operates the pump 4328 to increase the operating pressure of the accumulator in step 4406. The controller 4338 then determines if the operating pressure of the accumulator 4310, as sensed by the pressure sensor 4342, is greater than or equal to a predetermined value in step 4408. If the operating pressure of the accumulator 4310, as sensed by the pressure sensor 4342, in step 4408, is not greater than or equal to the predetermined value, then the controller 4338 continues to operate the pump 4328 to increase the operating pressure of the accumulator in step 4406.

[00326] If the operating pressure of the accumulator 4310, as sensed by the pressure sensor 4342, in steps 4404 or 4408, is greater than or equal to the predetermined value, then the controller 4338 operates the flow control valve 4306 to pressurize the expansion element 4302 in step 4410 by positioning the flow control valve to couple the flow lines 4304 and 4308 to one another. If the expansion operation has been completed in step 4412, then the controller 4338 operates the flow control valve 4306 to de-pressurize the expansion element 4302 in step 4414 by positioning the flow control valve to couple the flow lines 4304 and 4312 to one another.

[00327] In several exemplary embodiments, one or more of the hydroforming expansion devices 4002, 4104, and 4202, incorporate one or more elements of the hydroforming expansion system 4300 and/or the operational steps of the method 4400.

[00328] Referring to Fig. 45a, an exemplary embodiment of a liner hanger system 4500 includes a tubular support member 4502 that defines a passage 4502a and includes an externally threaded connection 4502b at an end. An internally threaded connection 4504a of an end of an outer tubular mandrel 4504 that defines a passage 4504b, and includes an external flange 4504c, an internal annular recess 4504d, an external annular recess 4504e, an external annular recess 4504f, an external flange 4504g, an external annular recess 4504h, an internal flange 4504i, an external flange 4504j, and a plurality of

circumferentially spaced apart longitudinally aligned teeth 4504k at another end, is coupled to and receives the externally threaded connection 4502b of the end of the tubular support member 4502.

[00329] An end of a tubular liner hanger 4506 that abuts and mates with an end face of the external flange 4504c of the outer tubular mandrel 4504 receives and mates with the outer tubular mandrel, and includes internal teeth 4506a, a plurality of circumferentially spaced apart longitudinally aligned internal teeth 4506b, an internal flange 4506c, and an external threaded connection 4506d at another end. In an exemplary embodiment, at least a portion of the tubular liner hanger 4506 includes one or more of the characteristics of the expandable tubular members described in the present application.

[00330] An internal threaded connection 4508a of an end of a tubular liner 4508 receives and is coupled to the external threaded connection 4506d of the tubular liner hanger 4506. Spaced apart elastomeric sealing elements, 4510, 4512, and 4514, are coupled to the exterior surface of the end of the tubular liner hanger 4506

[00331] An external flange 4516a of an end of an inner tubular mandrel 4516 that defines a longitudinal passage 4516b having a throat 4516ba and a radial passage 4516c and includes a sealing member 4516d mounted upon the external flange for sealingly engaging the inner annular recess 4504d of the outer tubular mandrel 4504, an external flange 4516e at another end that includes a plurality of circumferentially spaced apart teeth 4516f that mate with and engage the teeth, 4504k and 4506b, of the outer tubular mandrel 4504 and the tubular liner hanger 4506, respectively, for transmitting torsional loads therebetween, and another end that is received within and mates with the internal flange 4506c of the tubular liner hanger 4506 mates with and is received within the inner annular recess 4504d of the outer tubular mandrel 4504. A conventional rupture disc 4518 is received within and coupled to the radial passage 4516c of the inner tubular mandrel 4516.

[00332] A conventional packer cup 4520 is mounted within and coupled to the external annular recess 4504e of the outer tubular mandrel 4504 for sealingly engaging the interior surface of the tubular liner hanger 4506. A locking assembly 4522 is mounted upon and coupled to the outer tubular mandrel 4504 proximate the external flange 4504g in opposing relation to the internal teeth 4506a of the tubular liner hanger 4506 for controllably engaging and locking the position of the tubular liner hanger relative to the outer tubular mandrel 4504. In several exemplary embodiments, the locking assembly 4522 may be a conventional locking device for locking the position of a tubular member relative to another member. In several alternative embodiments, the locking assembly 4522 may include one or more elements of the locking assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number

PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00333] An adjustable expansion device assembly 4524 is mounted upon and coupled to the outer tubular mandrel 4504 between the locking assembly 4522 and the external flange 4504j for controllably radially expanding and plastically deforming the tubular liner hanger 4506. In several exemplary embodiments, the adjustable expansion device assembly 4524 may be a conventional adjustable expansion device assembly for radially expanding and plastically deforming tubular members that may include one or more elements of conventional adjustable expansion cones, mandrels, rotary expansion devices, hydroforming expansion devices and/or one or more elements of the one or more of the commercially available adjustable expansion devices of Enventure Global Technology LLC, Baker Hughes, Weatherford International, and/or Schlumberger and/or one or more elements of the adjustable expansion devices disclosed in one or more of the published patent applications and/or issued patents of Enventure Global Technology LLC, Baker Hughes, Weatherford International, Shell Oil Co. and/or Schlumberger. In several alternative embodiments, the adjustable expansion device assembly 4524 may include one or more elements of the adjustable expansion device assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent

application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00334] A conventional SSR plug set 4526 is mounted within and coupled to the internal flange 4506c of the tubular liner hanger 4506.

[00335] In an exemplary embodiment, during operation of the system 4500, as illustrated in Fig. 45a, the system is positioned within a wellbore 4528 that traverses a subterranean formation 4530 and includes a preexisting wellbore casing 4532 coupled to and positioned within the wellbore. In an exemplary embodiment, the system 4500 is positioned such that the tubular liner hanger 4506 overlaps with the casing 4532.

[00336] Referring to Fig. 45b, in an exemplary embodiment, a ball 4534 is then positioned in the throat passage 4516ba by injecting fluidic materials 4536 into the system 4500 through the passages 4502a, 4504b, and 4516b, of the tubular support member 4502, outer tubular mandrel 4504, and inner tubular mandrel 4516, respectively.

[00337] Referring to Fig. 45c, in an exemplary embodiment, the continued injection of the fluidic materials 4536 into the system 4500, following the placement of the ball 4534 in the throat passage 4516ba, pressurizes the passage 4516b of the inner tubular mandrel 4516 such that the rupture disc 4518 is ruptured thereby permitting the fluidic materials to pass through the radial passage 4516c of the inner tubular mandrel. As a result, the interior of the tubular liner hanger 4506 is pressurized.

[00338] Referring to Fig. 45d, in an exemplary embodiment, the continued injection of the fluidic materials 4536 into the interior of the tubular liner hanger 4506 radially expands

and plastically deforms at least a portion of the tubular liner hanger. In an exemplary embodiment, the continued injection of the fluidic materials 4536 into the interior of the tubular liner hanger 4506 radially expands and plastically deforms a portion of the tubular liner hanger positioned in opposition to the adjustable expansion device assembly 4524. In an exemplary embodiment, the continued injection of the fluidic materials 4536 into the interior of the tubular liner hanger 4506 radially expands and plastically deforms a portion of the tubular liner hanger positioned in opposition to the adjustable expansion device assembly 4524 into engagement with the wellbore casing 4532.

[00339] Referring to Fig. 45e, in an exemplary embodiment, the size of the adjustable expansion device assembly 4524 is then increased within the radially expanded portion of the tubular liner hanger 4506, and the locking assembly 4522 is operated to unlock the tubular liner hanger from engagement with the locking assembly. In an exemplary embodiment, the locking assembly 4522 and the adjustable expansion device assembly 4524 are operated using the operating pressure provided by the continued injection of the fluidic materials 4536 into the system 4500. In an exemplary embodiment, the adjustment of the adjustable expansion device assembly 4524 to a larger size radially expands and plastically deforms at least a portion of the tubular liner hanger 4506.

[00340] Referring to Fig. 45f, in an exemplary embodiment, the adjustable expansion device assembly 4524 is displaced in a longitudinal direction relative to the tubular liner hanger 4506 thereby radially expanding and plastically deforming the tubular liner hanger. In an exemplary embodiment, the tubular liner hanger 4506 is radially expanded and plastically deformed into engagement with the casing 4532. In an exemplary embodiment, the adjustable expansion device assembly 4524 is displaced in a longitudinal direction relative to the tubular liner hanger 4506 due to the operating pressure within the tubular liner hanger generated by the continued injection of the fluidic materials 4536. In an exemplary embodiment, the adjustable expansion device assembly 4524 is displaced in a longitudinal direction relative to the tubular liner hanger 4506 due to the operating pressure within the tubular liner hanger below the packer cup 4520 generated by the continued injection of the fluidic materials 4536. In this manner, the adjustable expansion device assembly 4524 is pulled through the tubular liner hanger 4506 by the operation of the packer cup 4520. In an exemplary embodiment, the adjustable expansion device assembly 4524 is displaced in a longitudinal direction relative to the tubular liner hanger 4506 thereby radially expanding and plastically deforming the tubular liner hanger until the internal flange 4504i of the outer tubular mandrel 4504 engages the external flange 4516a of the end of the inner tubular mandrel 4516.

[00341] Referring to Fig. 45g, in an exemplary embodiment, the 4504, due to the engagement of the internal flange 4504i of the outer tubular mandrel 4504 with the external

flange 4516a of the end of the inner tubular mandrel 4516, the inner tubular mandrel and the SSR plug set 4526 may be removed from the wellbore 4528. As a result, the tubular liner 4508 is suspended within the wellbore 4528 by virtue of the engagement of the tubular liner hanger 4506 with the wellbore casing 4532.

[00342] In several alternative embodiments, during the operation of the system 4500, a hardenable fluidic sealing material such as, for example, cement, may injected through the system 4500 before, during or after the radial expansion of the liner hanger 4506 in order to form an annular barrier between the wellbore 4528 and the tubular liner 4508.

[00343] In several alternative embodiments, during the operation of the system 4500, the size of the adjustable expansion device 4524 is increased prior to, during, or after the hydroforming expansion of the tubular liner hanger 4506 caused by the injection of the fluidic materials 4536 into the interior of the tubular liner hanger.

[00344] In several alternative embodiments, at least a portion of the tubular liner hanger 4506 includes a plurality of nested expandable tubular members bonded together by, for example, amorphous bonding.

[00345] In several alternative embodiments, at least a portion of the tubular liner hanger 4506 is fabricated for materials particularly suited for subsequent drilling out operations such as, for example, aluminum and/or copper based materials and alloys.

[00346] In several alternative embodiments, during the operation of the system 4500, the portion of the tubular liner hanger 4506 positioned below the adjustable expansion device 4524 is radially expanded and plastically deformed by displacing the adjustable expansion device downwardly.

[00347] In several alternative embodiments, at least a portion of the tubular liner hanger 4506 is fabricated for materials particularly suited for subsequent drilling out operations such as, for example, aluminum and/or copper based materials and alloys. In several alternative embodiments, during the operation of the system 4500, the portion of the tubular liner hanger 4506 fabricated for materials particularly suited for subsequent drilling out operations is not hydroformed by the injection of the fluidic materials 4536.

[00348] In several alternative embodiments, during the operation of the system 4500, at least a portion of the tubular liner hanger 4506 is hydroformed by the injection of the fluidic materials 4536, the remaining portion of the tubular liner hanger above the initial position of the adjustable expansion device 4524 is then radially expanded and plastically deformed by displacing the adjustable expansion device upwardly, and the portion of the tubular liner hanger below the initial position of the adjustable expansion device is radially expanded by then displacing the adjustable expansion device downwardly.

[00349] In several alternative embodiments, during the operation of the system 4500, the portion of the tubular liner hanger 4506 that is radially expanded and plastically deformed

is radially expanded and plastically deformed solely by hydroforming caused by the injection of the fluidic materials 4536.

[00350] In several alternative embodiments, during the operation of the system 4500, the portion of the tubular liner hanger 4506 that is radially expanded and plastically deformed is radially expanded and plastically deformed solely by the adjustment of the adjustable expansion device 4524 to an increased size and the subsequent displacement of the adjustable expansion device relative to the tubular liner hanger.

[00351] Referring to Fig. 46a, an exemplary embodiment of a system 4600 for radially expanding a tubular member includes a tubular support member 4602 that defines a passage 4602a. An end of a conventional tubular safety sub 4604 that defines a passage 4604a is coupled to an end of the tubular support member 4602, and another end of the safety sub 4604 is coupled to an end of a tubular casing lock assembly 4606 that defines a passage 4606a.

[00352] In several exemplary embodiments, the lock assembly 4606 may be a conventional locking device for locking the position of a tubular member relative to another member. In several alternative embodiments, the lock assembly 4606 may include one or more elements of the locking assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by

reference.

[00353] A end of a tubular support member 4608 that defines a passage 4608a and includes an outer annular recess 4608b is coupled to another end of the lock assembly 4606, and another end of the tubular support member 4608 is coupled to an end of a tubular support member 4610 that defines a passage 4610a, a radial passage 4610b, and includes an outer annular recess 4610c, an inner annular recess 4610d, and circumferentially spaced apart teeth 4610e at another end.

[00354] An adjustable expansion device assembly 4612 is mounted upon and coupled to the outer annular recess 4610c of the tubular support member 4610. In several exemplary embodiments, the adjustable expansion device assembly 4612 may be a conventional adjustable expansion device assembly for radially expanding and plastically deforming tubular members that may include one or more elements of conventional adjustable expansion cones, mandrels, rotary expansion devices, hydroforming expansion devices and/or one or more elements of the one or more of the commercially available adjustable expansion devices of Enventure Global Technology LLC, Baker Hughes, Weatherford International, and/or Schlumberger and/or one or more elements of the adjustable expansion devices disclosed in one or more of the published patent applications and/or issued patents of Enventure Global Technology LLC, Baker Hughes, Weatherford International, Shell Oil Co. and/or Schlumberger. In several alternative embodiments, the adjustable expansion device assembly 4524 may include one or more elements of the adjustable expansion device assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number

25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00355] An end of a float shoe 4614 that defines a passage 4614a having a throat 4614aa and includes a plurality of circumferentially spaced apart teeth 4614b at an end that mate with and engage the teeth 4610e of the tubular support member 4610 for transmitting torsional loads therebetween and an external threaded connection 4614c is received within the inner annular recess 4610d of the tubular support member.

[00356] An end of an expandable tubular member 4616 is coupled to the external threaded connection 4614c of the float shoe 4614 and another portion of the expandable tubular member is coupled to the lock assembly 4606. In an exemplary embodiment, at least a portion of the expandable tubular member 4616 includes one or more of the characteristics of the expandable tubular members described in the present application. In an exemplary embodiment, the portion of the expandable tubular member 4616 proximate and positioned in opposition to the adjustable expansion device assembly 4612 includes an outer expansion limiter sleeve 4618 for limiting the amount of radial expansion of the portion of the expandable tubular member proximate and positioned in opposition to the adjustable expansion device assembly. In an exemplary embodiment, at least a portion of the outer expansion limiter sleeve 4618 includes one or more of the characteristics of the expandable tubular members described in the present application.

[00357] A cup seal assembly 4620 is coupled to and positioned within the outer annular recess 4608b of the tubular support member 4608 for sealingly engaging the interior surface of the expandable tubular member 4616. A rupture disc 4622 is positioned within and coupled to the radial passage 4610b of the tubular support member 4610.

[00358] In an exemplary embodiment, during operation of the system 4600, as illustrated in Fig. 46a, the system is positioned within a wellbore 4624 that traverses a subterranean formation 4626 and includes a preexisting wellbore casing 4628 coupled to and positioned within the wellbore. In an exemplary embodiment, the system 4600 is positioned such that the expandable tubular member 4616 overlaps with the casing 4628.

[00359] Referring to Fig. 46b, in an exemplary embodiment, a plug 4630 is then positioned in the throat passage 4614aa of the float shoe 4614 by injecting fluidic materials 4632 into the system 4600 through the passages 4602a, 4604a, 4606a, 4608a, and 4610a, of the tubular support member 4602, safety sub 4604, lock assembly 4606, tubular support member 4608, and tubular support member 4610, respectively.

[00360] Referring to Fig. 46c, in an exemplary embodiment, the continued injection of the fluidic materials 4632 into the system 4600, following the placement of the plug 4630 in the throat passage 4614aa, pressurizes the passage 4610a of the tubular support member 4610 such that the rupture disc 4622 is ruptured thereby permitting the fluidic materials to pass through the radial passage 4610b of the tubular support member. As a result, the interior of the expandable tubular member 4616 proximate the adjustable expansion device assembly 4612 is pressurized.

[00361] Referring to Fig. 45d, in an exemplary embodiment, the continued injection of the fluidic materials 4632 into the interior of the expandable tubular member 4616 radially expands and plastically deforms at least a portion of the expandable tubular member. In an exemplary embodiment, the continued injection of the fluidic materials 4632 into the interior of the expandable tubular member 4616 radially expands and plastically deforms a portion of the expandable tubular member positioned in opposition to the adjustable expansion device assembly 4612. In an exemplary embodiment, the continued injection of the fluidic materials 4632 into the interior of the expandable tubular member 4616 radially expands and plastically deforms a portion of the expandable tubular member positioned in opposition to the adjustable expansion device assembly 4612 into engagement with the wellbore casing 4628. In an exemplary embodiment, the transformation of the material properties of the expansion limiter sleeve 4618, during the radial expansion process, limit the extent to which the expandable tubular member 4616 may be radially expanded.

[00362] Referring to Fig. 46e, in an exemplary embodiment, the size of the adjustable expansion device assembly 4612 is then increased within the radially expanded portion of the expandable tubular member 4616, and the lock assembly 4606 is operated to unlock the expandable tubular member from engagement with the lock assembly. In an exemplary embodiment, the lock assembly 4606 and the adjustable expansion device assembly 4612 are operated using the operating pressure provided by the continued injection of the fluidic materials 4632 into the system 4600. In an exemplary embodiment, the adjustment of the adjustable expansion device assembly 4612 to a larger size radially expands and plastically deforms at least a portion of the expandable tubular member 4616.

[00363] Referring to Fig. 46f, in an exemplary embodiment, the adjustable expansion device assembly 4612 is displaced in a longitudinal direction relative to the expandable tubular member 4616 thereby radially expanding and plastically deforming the expandable tubular member. In an exemplary embodiment, the expandable tubular member 4616 is radially expanded and plastically deformed into engagement with the casing 4628. In an exemplary embodiment, the adjustable expansion device assembly 4612 is displaced in a longitudinal direction relative to the expandable tubular member 4616 due to the

operating pressure within the expandable tubular member generated by the continued injection of the fluidic materials 4632.

[00364] In several alternative embodiments, during the operation of the system 4600, a hardenable fluidic sealing material such as, for example, cement, may injected through the system 4600 before, during or after the radial expansion of the expandable tubular member 4616 in order to form an annular barrier between the wellbore 4624 and/or the wellbore casing 4628 and the expandable tubular member.

[00365] In several alternative embodiments, during the operation of the system 4600, the size of the adjustable expansion device 4612 is increased prior to, during, or after the hydroforming expansion of the expandable tubular member 4616 caused by the injection of the fluidic materials 4632 into the interior of the expandable tubular member.

[00366] In several alternative embodiments, at least a portion of the expandable tubular member 4616 includes a plurality of nested expandable tubular members bonded together by, for example, amorphous bonding.

[00367] In several alternative embodiments, at least a portion of the expandable tubular member 4616 is fabricated for materials particularly suited for subsequent drilling out operations such as, for example, aluminum and/or copper based materials and alloys.

[00368] In several alternative embodiments, during the operation of the system 4600, the portion of the expandable tubular member 4616 positioned below the adjustable expansion device 4612 is radially expanded and plastically deformed by displacing the adjustable expansion device downwardly.

[00369] In several alternative embodiments, at least a portion of the expandable tubular member 4616 is fabricated for materials particularly suited for subsequent drilling out operations such as, for example, aluminum and/or copper based materials and alloys. In several alternative embodiments, during the operation of the system 4600, the portion of the expandable tubular member 4616 fabricated for materials particularly suited for subsequent drilling out operations is not hydroformed by the injection of the fluidic materials 4632.

[00370] In several alternative embodiments, during the operation of the system 4600, at least a portion of the expandable tubular member 4616 is hydroformed by the injection of the fluidic materials 4632, the remaining portion of the expandable tubular member above the initial position of the adjustable expansion device 4612 is then radially expanded and plastically deformed by displacing the adjustable expansion device upwardly, and the portion of the expandable tubular member below the initial position of the adjustable expansion device is radially expanded by then displacing the adjustable expansion device downwardly.

[00371] In several alternative embodiments, during the operation of the system 4600, the portion of the expandable tubular member 4616 that is radially expanded and plastically

deformed is radially expanded and plastically deformed solely by hydroforming caused by the injection of the fluidic materials 4632.

[00372] In several alternative embodiments, during the operation of the system 4600, the portion of the expandable tubular member 4616 that is radially expanded and plastically deformed is radially expanded and plastically deformed solely by the adjustment of the adjustable expansion device 4612 to an increased size and the subsequent displacement of the adjustable expansion device relative to the expandable tubular member.

[00373] In an exemplary experimental embodiment, expandable tubular members fabricated from tellurium copper, leaded naval brass, phosphorous bronze, and aluminum-silicon bronze were successfully hydroformed and thereby radially expanded and plastically deformed by up to about 30% radial expansion, all of which were unexpected results.

[00374] Referring to Fig. 46g, in an exemplary embodiment, at least a portion of the expansion limiter sleeve 4618, prior to the radial expansion and plastic deformation of the expansion limiter sleeve by operation of the system 4600, includes one or more diamond shaped slots 4618a. Referring to Fig. 46h, in an exemplary embodiment, during the radial expansion and plastic deformation of the expansion limiter sleeve by operation of the system 4600, the diamond shaped slots 4618a are deformed such that further radial expansion of the expansion limiter sleeve requires increased force. More generally, the expansion limiter sleeve 4618 may be manufactured with slots whose cross sectional areas are decreased by the radial expansion and plastic deformation of the expansion limited sleeve thereby increasing the amount of force required to further radially expand the expansion limiter sleeve. In this manner, the extent to which the expandable tubular member 4616 may be radially expanded is limited. In several alternative embodiments, at least a portion of the expandable tubular member 4616 includes slots whose cross sectional areas are decreased by the radial expansion and plastic deformation of the expandable tubular member thereby increasing the amount of force required to further radially expand the expandable tubular member.

[00375] Referring to Figs. 46i and 46ia, in an exemplary embodiment, at least a portion of the expansion limiter sleeve 4618, prior to the radial expansion and plastic deformation of the expansion limiter sleeve by operation of the system 4600, includes one or more wavy circumferentially oriented spaced apart bands 4618b. Referring to Fig. 46j, in an exemplary embodiment, during the radial expansion and plastic deformation of the expansion limiter sleeve by operation of the system 4600, the bands 4618b are deformed such that the further radial expansion of the expansion limiter sleeve requires added force. More generally, the expansion limiter sleeve 4618 may be manufactured with a circumferential bands whose orientation becomes more and more aligned with a direction that is orthogonal to the longitudinal axis of the sectional areas as a result of the radial

expansion and plastic deformation of the bands thereby increasing the amount of force required to further radially expand the expansion limiter sleeve. In this manner, the extent to which the expandable tubular member 4616 may be radially expanded is limited. In several alternative embodiments, at least a portion of the expandable tubular member 4616 includes circumferential bands whose orientation becomes more and more aligned with a direction that is orthogonal to the longitudinal axis of the sectional areas as a result of the radial expansion and plastic deformation of the bands thereby increasing the amount of force required to further radially expand the expandable tubular member.

[00376] In several exemplary embodiments, the design of the expansion limiter sleeve 4618 provides a restraining force that limits the extent to which the expandable tubular member 4616 may be radially expanded and plastically deformed. Furthermore, in several exemplary embodiments, the design of the expansion limiter sleeve 4618 provides a variable restraining force that limits the extent to which the expandable tubular member 4616 may be radially expanded and plastically deformed. In several exemplary embodiments, the variable restraining force of the expansion limiter sleeve 4618 increases in proportion to the degree to which the expandable tubular member 4616 has been radially expanded.

[00377] Referring to Fig. 47a, an exemplary embodiment of a system 4700 for radially expanding a tubular member includes a tubular support member 4702 that defines a passage 4702a. An end of a conventional tubular safety sub 4704 that defines a passage 4704a is coupled to an end of the tubular support member 4702, and another end of the safety sub 4704 is coupled to an end of a tubular ball gripper assembly 4706 that defines a passage 4706a.

[00378] In several exemplary embodiments, the ball gripper assembly 4706 may be a conventional device for limiting movement of tubular member relative to another member that employs, for example, one or more separate discrete ball-like elements to controllably engage and limit relative movement of the tubular member in one or more directions. In several alternative embodiments, the ball gripper assembly 4706 may include one or more elements of the ball grabber assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT

patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00379] An end of a tubular casing lock assembly 4708 that defines a passage 4708a is coupled to the other end of the ball gripper assembly 4706. In several exemplary embodiments, the casing lock assembly 4708 may be a conventional device for limiting movement of a tubular member relative to another member. In several alternative embodiments, the casing lock assembly 4708 may include one or more elements of the casing lock assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number

25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00380] An end of a tubular tension actuator assembly 4710 that defines a passage 4710a and one or more external mounting holes 4710b and includes an internal annular recess 4710c at one end is coupled to the other end of the casing lock assembly 4708. In several exemplary embodiments, the tubular tension actuator assembly 4710 may be a conventional device for displacing a member relative to another member. In several alternative embodiments, the tubular tension actuator assembly 4710 may include one or more elements of the tension actuator assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00381] A primary solid tubular expansion cone 4712 that includes a tapered external surface 4712a at one end 4712b is coupled to the other end of the tubular tension actuator assembly 4710. An expandable tubular casing 4714 that defines one or more mounting holes 4714a at one end receives and mates with the safety sub 4704, ball gripper assembly 4706, casing lock assembly 4708, tension actuator assembly 4710. The end of the tubular casing 4714 receives and mates with the non-tapered end and a portion of the tapered end 4712b of the tubular expansion cone 4712. As a result, the end of the tubular casing 4714

that receives and mates with the portion of the tapered end 4712b of the tubular expansion cone 4712 is flared. In an exemplary embodiment, the outside diameter of the flared tapered end of the tubular casing 4714 is less than or equal to the maximum outside diameter of the tapered end 4712b of the tubular expansion cone 4712. An end of a mounting pin 4716 is received within and coupled to the mounting hole 4710b of the tension actuator assembly 4710, and another end of the mounting pin is received within and coupled to the mounting hole 4714a of the tubular casing 4714. In an exemplary embodiment, the expandable tubular casing 4714 is provided and includes one or more of the properties of the expandable tubulars described above with reference to Figs. 1 to 46j. In an exemplary embodiment, during the operation of the system 4700, the mounting pin 4716 permits torque to be transmitted between the expandable tubular casing 4714 and the tension actuator assembly 4710.

[00382] An end of a secondary tubular expansion cone 4718 that defines a passage 4718a and includes an external annular recess 4718b, that mates with and is received within the end of the tension actuator assembly 4710 and the primary tubular expansion cone 4712, and a tapered external surface 4718c, an internal annular recess 4718d, and a plurality of circumferentially spaced apart teeth 4718e at another end is coupled to the end of the tension actuator assembly 4710. An expandable tubular sleeve 4720 that includes a first end 4720a including an external annular recess 4720aa, an intermediate portion 4720b, and a second end 4720c having an internal threaded connection 4720d mates with and receives the secondary tubular expansion cone 4718. In an exemplary embodiment, the expandable tubular sleeve 4720 is provided and includes one or more of the properties of the expandable tubulars described above with reference to Figs. 1 to 46j. A sealing member 4722 is received within and coupled to the external annular recess 4720aa of the first end 4720a of the expandable tubular sleeve 4720. In an exemplary embodiment, the wall thickness of the first end 4720a of the tubular sleeve 4720 is greater than the wall thickness of the second end 4720c of the tubular sleeve, and the wall thickness of the intermediate portion 4720b of the tubular sleeve is tapered. In an exemplary embodiment, the outside diameter of the intermediate portion 4720b and the second end 4720c of the tubular sleeve 4720 are both less than or equal to the maximum outside diameter of the tapered end 4712b of the tubular expansion cone 4712. In an exemplary embodiment, the outside diameter of the sealing member 4722 is less than or equal to the maximum outside diameter of the tapered end 4712b of the tubular expansion cone 4712.

[00383] A float shoe 4724 that defines a passage 4724a having a throat 4724aa and a passage 4724b and includes an external annular recess 4724c at one end that is received within and mates with the internal annular recess 4718d of the end of the secondary tubular expansion cone 4718, a plurality of circumferentially spaced apart shoulders 4724d at

another end, a plurality of circumferentially spaced apart teeth 4724e for engaging the circumferentially spaced apart teeth 4718e of the secondary tubular expansion cone 4718, and a conventional float element 4724f is received within, mates with, and is coupled to the internal threaded connection 4720d of the end of the expandable tubular sleeve 4720. In an exemplary embodiment, the outside diameter of the spaced apart shoulders 4724d of the float shoe 4724 are greater than the outside diameter of the maximum outside diameter of the tapered end 4712b of the tubular expansion cone 4712. In an exemplary embodiment, during the operation of the system 4700, the interaction of the circumferentially spaced apart teeth 4724e of the float shoe 4724 with the circumferentially spaced apart teeth 4718e of the secondary tubular expansion cone 4718 permits torque loads to be transmitted there between. In an exemplary embodiment, during the operation of the system 4700, the circumferentially spaced apart shoulders 4724d further define circumferentially spaced apart axial flow passages there between.

[00384] In an exemplary embodiment, during operation of the system 4700, as illustrated in Fig. 47a, the system is positioned within a wellbore 4726 that traverses a subterranean formation 4728. A hardenable fluidic sealing material 4730 such as, for example, cement may then be injected into the system 4700 through the passages 4702a, 4704a, 4706a, 4708a, 4710a, 4718a, and 4724a. The fluidic material 4730 may then be conveyed past the float element 4724f of the float shoe 4724 and through the passage 4724b into an annulus 4732 between the system 4700 and the interior surface of the wellbore 4726. The fluidic material 4730 within the annulus 4732 may then be allowed to at least partially cure.

[00385] In an exemplary embodiment, during the operation of the system 4700, as illustrated in Fig. 47b, a conventional plug 4734 is then positioned within the throat 4724aa of the passage 4724a of the float shoe 4724 by injecting fluidic material 4736 into the system 4700 through the passages 4702a, 4704a, 4706a, 4708a, 4710a, 4718a, and 4724a. As a result, the passage 4724a of the float shoe 4724 is blocked and the passages 4702a, 4704a, 4706a, 4708a, 4710a, and 4718a may be pressurized by the continued injection of the fluidic material 4736.

[00386] In an exemplary embodiment, during the operation of the system 4700, as illustrated in Fig. 47c, the passages 4702a, 4704a, 4706a, 4708a, 4710a, and 4718a may be pressurized by the continued injection of the fluidic material 4736 into the system. As a result, the casing lock assembly 4708 is operated to engage the expandable tubular casing 4714and the tension actuator assembly 4710 is operated to displace the primary tubular expansion cone 4712, secondary tubular expansion cone 4718, expandable tubular sleeve 4720, sealing member 4722, and float shoe 4724 upwardly in a longitudinal direction 4738 relative to the expandable tubular casing 4714. As a result, the end of the expandable

tubular casing 4714 is radially expanded and plastically deformed by the tapered external surface 4712a of the primary tubular expansion cone 4712. Furthermore, as a result, the radially expanded and plastically deformed end of the tubular casing 4714 receives and mates with the expandable tubular sleeve 4720 and the sealing member 4722. Furthermore, as a result, the mounting pin 4716 is sheared. In an exemplary embodiment, the of the expandable tubular casing 4714 is radially expanded and plastically deformed by the tapered external surface 4712a of the primary tubular expansion cone 4712 until the end of the expandable tubular casing impacts the end face of the shoulders 4724d of the float shoe 4724.

[00387] In an exemplary embodiment, during the operation of the system 4700, as illustrated in Fig. 47d, the passages 4702a, 4704a, 4706a, 4708a, 4710a, and 4718a may continue to be pressurized by the continued injection of the fluidic material 4736 into the system. As a result, the casing lock assembly 4708 and the tension actuator assembly 4710 may continue to be operated in the manner described above with reference to Fig. 47c. Furthermore, as a result, the primary tubular expansion cone 4712 is further displaced upwardly in the longitudinal direction 4738 relative to the expandable tubular casing 4714, and the secondary tubular expansion cone 4718 is displaced upwardly relative to the expandable tubular sleeve 4720, and the sealing member 4722 in the longitudinal direction 4738. Note that the further upward displacement of the expandable tubular sleeve 4720, the sealing member 4722, and the float shoe 4724, during the continued operation of the tension actuator assembly 4710, is prevented due to the interaction between the end of the expandable tubular casing 4714 and the end face of the shoulders 4724d of the float shoe 4724. Furthermore, as a result, the end of the expandable tubular casing 4714 is further radially expanded and plastically deformed by the tapered external surface 4712a of the primary tubular expansion cone 4712, and portions, 4720a and 4720b, of the expandable tubular sleeve 4720 are radially expanded and plastically deformed by the tapered external surface 4718c of the secondary tubular expansion cone 4718 within the expandable tubular casing. As a result, the sealing member 4722 engages and fluidicly seals the interface between the expandable tubular casing 4714 and the expandable tubular sleeve 4720. Furthermore, in an exemplary embodiment, as a result of the radial expansion and plastic deformation of the portions, 4720a and 4720b, of the expandable tubular sleeve 4720 within the expandable tubular casing 4714, a metal to metal, fluid tight seal is formed between the interior surface of the expandable tubular casing and the exterior surface of the expandable tubular sleeve. In an exemplary embodiment, once the portions, 4720a and 4720b, of the expandable tubular sleeve 4720 are completely radially expanded and plastically deformed by the tapered external surface 4718c of the secondary tubular expansion cone 4718, the casing lock assembly 4708 releases the expandable tubular casing 4714.

[00388] In an exemplary embodiment, during the operation of the system 4700, as illustrated in Fig. 47e, following the release of the expandable tubular casing 4714 from the casing lock assembly 4708, the continued injection of the fluidic material 4736 into the passages of the system will further displace the primary tubular expansion cone 4712 upwardly in the longitudinal direction 4738 relative to the expandable tubular casing 4714. As a result, the expandable tubular casing 4714 is further radially expanded and plastically deformed by the tapered external surface 4712a of the primary tubular expansion cone 4712.

[00389] In several alternative embodiments, the tension actuator assembly 4710 may be operated to radially expand and plastically deform the expandable tubular sleeve 4720 by operating the tension actuator assembly in a first stroke to radially expand and plastically deform a portion of the expandable tubular sleeve 4720. After completing the first stroke of the tension actuator assembly 4710, the casing lock assembly 4708 is operated to release the expandable tubular casing 4714, such as, for example, by reducing the operating pressure of the fluidic material 4736. The tension actuator assembly 4710 is then re-set to an initial position by displacing the tubular support member 4702, the tubular safety sub 4704, the ball gripper assembly 4706, the casing lock assembly, and the portion of the tension actuator assembly rigidly coupled to the end of the casing lock assembly upwardly relative to the expandable tubular casing 4714. The operating pressure of the fluidic material 4736 is increased, and the tension actuator assembly is then operated in a second stroke to radially expand and plastically deform a further portion of the expandable tubular sleeve 4720. In several exemplary embodiments, this process may be repeated as often as required in order to radially expand and plastically deform the desired portions of the expandable tubular sleeve 4720. In an exemplary embodiment, during the first stroke, re-setting of, and/or the second stroke of the tension actuator assembly 4710, the ball gripper assembly 4706 is also operated to limit displacement of the expandable tubular casing 4714 in one or more longitudinal directions by, for example, adjusting the operating pressure of the fluidic material 4736.

[00390] In an exemplary embodiment, the maximum outside diameter of the system 4700, during the placement of the system within the wellbore 4726, is defined by the maximum outside diameter of the expandable tubular casing 4714.

[00391] In several alternative embodiments, the system 4700 includes the ball gripper assembly 4706 and/or the casing lock assembly 4708.

[00392] In several alternative embodiments, the casing lock assembly 4708 is omitted from the system 4700. As a result, the system 4700 relies only upon the ball gripper assembly 4706 to limit displacement of the expandable tubular casing 4714.

[00393] In several exemplary embodiments of the system 4700, the operation of the ball gripper assembly 4706 and/or the casing lock assembly 4708 may be replaced with, or enhanced by, the use of conventional hydraulic or mechanical slips.

[00394] In several exemplary embodiments of the system 4700, the expandable tubular sleeve 4720 is fabricated from materials particularly suited to being removed using a drilling device such as, for example, aluminum or brass.

[00395] In several exemplary embodiments of the system 4700, the float shoe 4724 may include a sliding sleeve valve for controlling the flow of fluidic materials through the float shoe. In several exemplary embodiments of the system 4700, the secondary tubular expansion cone 4718 includes a conventional stinger attached thereto for manipulating and thereby controlling the operation of the sliding sleeve valve.

[00396] Referring to Fig. 48a, an exemplary embodiment of a system 4800 for radially expanding a tubular member includes a tubular support member 4802 that defines a passage 4802a. An end of a conventional tubular safety sub 4804 that defines a passage 4804a is coupled to an end of the tubular support member 4802, and another end of the safety sub 4804 is coupled to an end of a tubular ball gripper assembly 4806 that defines a passage 4806a.

[00397] In several exemplary embodiments, the ball gripper assembly 4806 may be a conventional device for limiting movement of tubular member relative to another member that employs, for example, one or more separate discrete ball-like elements to controllably engage and limit relative movement of the tubular member in one or more directions. In several alternative embodiments, the ball gripper assembly 4806 may include one or more elements of the ball gripper assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number

PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00398] An end of a tubular casing lock assembly 4808 that defines a passage 4808a is coupled to the other end of the ball gripper assembly 4806. In several exemplary embodiments, the casing lock assembly 4808 may be a conventional device for limiting movement of a tubular member relative to another member. In several alternative embodiments, the casing lock assembly 4808 may include one or more elements of the casing lock assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00399] An end of a tubular tension actuator assembly 4810 that defines a passage 4810a is coupled to the other end of the casing lock assembly 4808. In several exemplary embodiments, the tubular tension actuator assembly 4810 may be a conventional device for

displacing a member relative to another member. In several alternative embodiments, the tubular tension actuator assembly 4810 may include one or more elements of the tension actuator assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00400] An end of a tubular support member 4812 that defines a passage 4812a and includes an external annular recess 4812b is coupled to the other end of the tubular tension actuator assembly 4810. A sealing cup assembly 4814 is positioned within and coupled to the external annular recess 4812b of the 4812. In several exemplary embodiments, the sealing cup assembly 4814 may include one or more conventional sealing cup assemblies and/or one or more of the elements of one or more of the sealing cup assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6)

PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00401] An end of an expansion device assembly 4816 that defines a passage 4816a and a mounting hole 4816aa and includes an adjustable expansion device 4816b at one end, an external annular recess 4816c, a tapered external expansion surface 4816d, an internal annular recess 4816e, and a plurality of circumferentially spaced apart teeth 4816f at another end is coupled to the other end of the tubular support member 4812. In several exemplary embodiments, the adjustable expansion device 4816b may be a conventional adjustable expansion device that may include a tapered outer expansion surface whose shape, size, and/or position is adjustable, a rotary expansion device, one or more of the elements of the conventional commercially available expansion devices of Baker Hughes, Halliburton, Schlumberger, Weatherford, and/or Enventure Global Technology, L.L.C. and/or one or more of the elements of the issued patents and published patent applications assigned or licensed to Baker Hughes, Halliburton, Schlumberger, Weatherford, and/or Enventure Global Technology, L.L.C. In several exemplary embodiments, the adjustable expansion device 4816b includes one or more elements of one or more of the adjustable expansion devices disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent

application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00402] An end of a mounting pin 4818 is received within and coupled to the mounting hole 4816aa of the expansion device assembly 4816, and another of the mounting pin is received within a mounting hole 4820a defined within an expandable tubular casing 4820 that receives the tubular support member 4802, the tubular safety sub 4804, the tubular ball gripper assembly 4806, the tubular casing lock assembly 4808, the tubular tension actuator assembly 4810, the tubular support member 4812, the sealing cup assembly 4814, and the end of the expansion device assembly 4816.

[00403] In an exemplary embodiment, the expandable tubular casing 4820 is provided and includes one or more of the properties of the expandable tubulars described above with reference to Figs. 1 to 46j. In an exemplary embodiment, during the operation of the system 4800, the mounting pin 4818 permits torque to be transmitted between the expandable tubular casing 4820 and the expansion device assembly 4816. In an exemplary embodiment, the torque pin 4818 is fabricated from a drillable material such as, for example, brass or aluminum. In an exemplary embodiment, the sealing cup assembly 4814 sealingly engages the internal diameter of the expandable tubular casing 4820 during the operation of the system 4800.

[00404] An expandable tubular sleeve 4822 that includes a first end 4822a including an external annular recess 4822aa, an intermediate portion 4822b, and a second end 4822c having an internal threaded connection 4822d mates with and is received within the external annular recess 4816c of the expansion device assembly 4816. In an exemplary embodiment, the wall thickness of the first end 4822a of the expandable tubular sleeve 4822 is greater than the wall thickness of the second end 4822c of the expandable tubular sleeve, and the wall thickness of the intermediate portion 4822b of the expandable tubular sleeve is tapered. In an exemplary embodiment, the intermediate portion 4822b of the expandable

tubular sleeve 4822 mates with and receives the external tapered surface 4816d of the expansion device assembly 4816. In an exemplary embodiment, the expandable tubular sleeve 4822 is provided and includes one or more of the properties of the expandable tubulars described above with reference to Figs. 1 to 46j.

[00405] A sealing member 4824 is received within and coupled to the external annular recess 4822aa of the first end 4822a of the expandable tubular sleeve 4822. In an exemplary embodiment, the outside diameter of the intermediate portion 4822b and the second end 4822c of the tubular sleeve 4822 are both less than or equal to the maximum outside diameter of the expandable tubular casing 4822. In an exemplary embodiment, the outside diameter of the sealing member 4824 is less than or equal to the maximum outside diameter of the expandable tubular casing 4820.

[00406] A float shoe 4826 that defines a passage 4826a having a throat 4826aa and a passage 4826b and includes an external annular recess 4826c at one end that is received within and mates with the internal annular recess 4816e of the end of the expansion device assembly 4816, a plurality of circumferentially spaced apart shoulders 4826d at another end, a plurality of circumferentially spaced apart teeth 4826e for engaging the circumferentially spaced apart teeth 4816f of the end of the expansion device assembly 4816, and a conventional float element 4826f is received within, mates with, and is coupled to the internal threaded connection 4822d of the end of the expandable tubular sleeve 4822. In an exemplary embodiment, the outside diameter of the spaced apart shoulders 4826d of the float shoe 4826 are greater than the outside diameters of both the expandable tubular casing 4820 and the expandable tubular sleeve 4822. In an exemplary embodiment, during the operation of the system 4800, the interaction of the circumferentially spaced apart teeth 4826e of the float shoe 4826 with the circumferentially spaced apart teeth 4816f of the expansion device assembly 4816 permits torque loads to be transmitted there between. In an exemplary embodiment, during the operation of the system 4800, the circumferentially spaced apart shoulders 4826d further define circumferentially spaced apart axial flow passages there between.

[00407] In an exemplary embodiment, during operation of the system 4800, as illustrated in Fig. 48a, the system is positioned within a wellbore 4828 that traverses a subterranean formation 4830. A hardenable fluidic sealing material 4832 such as, for example, cement may then be injected into the system 4800 through the passages 4802a, 4804a, 4806a, 4808a, 4810a, 4812a, 4816a, and 4826a. The fluidic material 4832 may then be conveyed past the float element 4826f of the float shoe 4826 and through the passage 4826b into an annulus 4834 between the system 4800 and the interior surface of the wellbore 4828. The fluidic material 4832 within the annulus 4834 may then be allowed to at least partially cure.

[00408] In an exemplary embodiment, during the operation of the system 4800, as illustrated in Fig. 48b, a conventional plug 4836 is then positioned within the throat 4826aa of the passage 4826a of the float shoe 4826 by injecting fluidic material 4838 into the system 4800 through the passages 4802a, 4804a, 4806a, 4808a, 4810a, 4812a, and 4816a. As a result, the passage 4826a of the float shoe 4826 is blocked and the passages 4802a, 4804a, 4806a, 4808a, 4810a, 4812a, and 4816a may be pressurized by the continued injection of the fluidic material 4838.

[00409] In an exemplary embodiment, during the operation of the system 4800, as illustrated in Fig. 48c, the passages 4802a, 4804a, 4806a, 4808a, 4810a, 4812a and 4816a may be pressurized by the continued injection of the fluidic material 4838 into the system. As a result, the casing lock assembly 4808 is operated to engage the expandable tubular casing 4820 and the outside diameter of the adjustable expansion device 4816b of the expansion device assembly 4816 is increased. In an exemplary embodiment, the adjustable expansion device 4816b of the expansion device assembly 4816 includes one or more external expansion surfaces 4816ba for engaging and radially expanding and plastically deforming the expandable tubular casing 4820.

[00410] In an exemplary embodiment, during the operation of the system 4800, as illustrated in Fig. 48d, the passages 4802a, 4804a, 4806a, 4808a, 4810a, 4812a and 4816a may continue to be pressurized by the continued injection of the fluidic material 4838 into the system. As a result, the casing lock assembly 4808 continues to be operated to engage the expandable tubular casing 4820 and the tension actuator assembly 4810 is operated to displace the expansion device assembly 4816, expandable tubular sleeve 4822, sealing member 4824, and float shoe 4826 upwardly in a longitudinal direction 4840 relative to the expandable tubular casing 4820. As a result, the end of the expandable tubular casing 4820 is radially expanded and plastically deformed by the external expansion surfaces 4816ba of the adjustable expansion device 4816b of the expansion device assembly 4816. Furthermore, as a result, the radially expanded and plastically deformed end of the tubular casing 4820 receives and mates with the expandable tubular sleeve 4822 and the sealing member 4824. Furthermore, as a result, the mounting pin 4818 is sheared. In an exemplary embodiment, the end of the expandable tubular casing 4820 is radially expanded and plastically deformed by the external expansion surfaces 4816ba of the adjustable expansion device 4816b of the expansion device assembly 4816 until the end of the expandable tubular casing impacts the end face of the shoulders 4826d of the float shoe 4826.

[00411] In an exemplary embodiment, during the operation of the system 4800, as illustrated in Fig. 48e, the passages 4802a, 4804a, 4806a, 4808a, 4810a, 4812a, and 4816a may continue to be pressurized by the continued injection of the fluidic material 4838 into the system. As a result, the casing lock assembly 4808 and the tension actuator assembly 4810

may continue to be operated in the manner described above with reference to Fig. 48d. Furthermore, as a result, the adjustable expansion device 4816b of the expansion device assembly 4816 is further displaced upwardly in the longitudinal direction 4840 relative to the expandable tubular casing 4820, and the tapered external expansion surface 4816d of the expansion device assembly is displaced upwardly relative to the expandable tubular sleeve 4822, and the sealing member 4824 in the longitudinal direction 4838. Note that the further upward displacement of the expandable tubular sleeve 4822, the sealing member 4824, and the float shoe 4826, during the continued operation of the tension actuator assembly 4810, is prevented due to the interaction between the end of the expandable tubular casing 4820 and the end face of the shoulders 4826d of the float shoe 4826. Furthermore, as a result, the end of the expandable tubular casing 4820 is further radially expanded and plastically deformed by the external expansion surfaces 4816ba of the adjustable expansion device 4816b of the expansion device assembly 4816, and portions, 4822a and 4822b, of the expandable tubular sleeve 4822 are radially expanded and plastically deformed by the tapered external expansion surface 4816d of the expansion device assembly within the end of the expandable tubular casing. As a result, the sealing member 4824 engages and fluidicly seals the interface between the expandable tubular casing 4820 and the expandable tubular sleeve 4822. Furthermore, in an exemplary embodiment, as a result of the radial expansion and plastic deformation of the portions, 4822a and 4822b, of the expandable tubular sleeve 4822 within the end of the expandable tubular casing 4820, a metal to metal, fluid tight seal is formed between the interior surface of the expandable tubular casing and the exterior surface of the expandable tubular sleeve. In an exemplary embodiment, once the portions, 4822a and 4822b, of the expandable tubular sleeve 4822 are completely radially expanded and plastically deformed by the tapered external expansion surface 4816d of the expansion device assembly 4816, the casing lock assembly 4808 releases the expandable tubular casing 4820.

[00412] In an exemplary embodiment, during the operation of the system 4800, as illustrated in Fig. 48f, following the release of the expandable tubular casing 4820 from the casing lock assembly 4808, the continued injection of the fluidic material 4838 into the passages of the system will further displace the adjustable expansion device 4816b of the expansion device assembly 4816 upwardly in the longitudinal direction 4840 relative to the expandable tubular casing 4820. In an exemplary embodiment, during the displacement of the adjustable expansion device 4816b of the expansion device assembly 4816 upwardly in the longitudinal direction 4840 relative to the expandable tubular casing 4820, the sealing cup assembly 4814 sealingly engage the internal surface of the expandable tubular casing 4820. As a result, the annulus within the expandable tubular casing 4820 below and proximate to the sealing cup assembly 4814 is pressurized by the injection of the fluidic

material 4838 into the system 4800 thereby applying an upward axial force to the tubular support member 4812. As a result, the adjustable expansion device 4816b of the expansion device assembly 4816 is pulled through the expandable tubular casing 4820. As a result, the expandable tubular casing 4820 is further radially expanded and plastically deformed by the external expansion surfaces 4816ba of the adjustable expansion device 4816b of the expansion device assembly 4816.

[00413] In several alternative embodiments, the tension actuator assembly 4810 may be operated to radially expand and plastically deform the expandable tubular sleeve 4822 by operating the tension actuator assembly in a first stroke to radially expand and plastically deform a portion of the expandable tubular sleeve 4822. After completing the first stroke of the tension actuator assembly 4810, the casing lock assembly 4808 is operated to release the expandable tubular casing 4820, such as, for example, by reducing the operating pressure of the fluidic material 4838. The tension actuator assembly 4810 is then re-set to an initial position by displacing the tubular support member 4802, the tubular safety sub 4804, the ball gripper assembly 4806, the casing lock assembly 4808, and the portion of the tension actuator assembly rigidly coupled to the end of the casing lock assembly upwardly relative to the expandable tubular casing 4820. The operating pressure of the fluidic material 4838 is increased, and the tension actuator assembly 4810 is then operated in a second stroke to radially expand and plastically deform a further portion of the expandable tubular sleeve 4822. In several exemplary embodiments, this process may be repeated as often as required in order to radially expand and plastically deform the desired portions of the expandable tubular sleeve 4822. In an exemplary embodiment, during the first stroke, re-setting of, and/or the second stroke of the tension actuator assembly 4810, the ball gripper assembly 4806 is also operated to limit displacement of the expandable tubular casing 4820 in one or more longitudinal directions by, for example, adjusting the operating pressure of the fluidic material 4838.

[00414] In an exemplary embodiment, the maximum outside diameter of the system 4800, during the placement of the system within the wellbore 4828, is defined by the maximum outside diameter of the expandable tubular casing 4820.

[00415] In several alternative embodiments, the system 4800 includes the ball gripper assembly 4806 and/or the casing lock assembly 4808.

[00416] In several alternative embodiments, the casing lock assembly 4808 is omitted from the system 4800. As a result, the system 4800 relies only upon the ball gripper assembly 4806 to limit displacement of the expandable tubular casing 4820.

[00417] In several exemplary embodiments of the system 4800, the operation of the ball gripper assembly 4806 and/or the casing lock assembly 4808 may be replaced with, or enhanced by, the use of conventional hydraulic or mechanical slips.

[00418] In several exemplary embodiments of the system 4800, the expandable tubular sleeve 4822 is fabricated from materials particularly suited to being removed using a drilling device such as, for example, aluminum or brass.

[00419] In several exemplary embodiments of the system 4800, the float shoe 4826 may include a sliding sleeve valve for controlling the flow of fluidic materials through the float shoe. In several exemplary embodiments of the system 4800, the end of the expansion device assembly 4816 includes a conventional stinger attached thereto for manipulating and thereby controlling the operation of the sliding sleeve valve.

[00420] In several exemplary embodiments, the sealing cup assembly 4814 may be positioned above or below the casing lock assembly 4808.

[00421] Referring to Fig. 49a, an exemplary embodiment of a system 4900 for radially expanding a tubular member includes a tubular support member 4902 that defines a passage 4902a. An end of a conventional tubular safety sub 4904 that defines a passage 4904a is coupled to an end of the tubular support member 4902, and another end of the safety sub 4904 is coupled to an end of a tubular ball gripper assembly 4906 that defines a passage 4906a.

[00422] In several exemplary embodiments, the ball gripper assembly 4906 may be a conventional device for limiting movement of tubular member relative to another member that employs, for example, one or more separate discrete ball-like elements to controllably engage and limit relative movement of the tubular member in one or more directions. In several alternative embodiments, the ball gripper assembly 4906 may include one or more elements of the ball gripper assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT

patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00423] An end of a tubular casing lock assembly 4908 that defines a passage 4908a is coupled to the other end of the ball gripper assembly 4908. In several exemplary embodiments, the casing lock assembly 4908 may be a conventional device for limiting movement of a tubular member relative to another member. In several alternative embodiments, the casing lock assembly 4908 may include one or more elements of the casing lock assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00424] An end of a tubular tension actuator assembly 4910 that defines a passage 4910a is coupled to the other end of the casing lock assembly 4908. In several exemplary embodiments, the tubular tension actuator assembly 4910 may be a conventional device for displacing a member relative to another member. In several alternative embodiments, the

tubular tension actuator assembly 4910 may include one or more elements of the tension actuator assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00425] An end of a tubular support member 4912 that defines a passage 4912a and includes an external annular recess 4912b is coupled to the other end of the tubular tension actuator assembly 4910. A sealing cup assembly 4914 is positioned within and coupled to the external annular recess 4912b of the tubular support member 4912. In several exemplary embodiments, the sealing cup assembly 4914 may include one or more conventional sealing cup assemblies and/or one or more of the elements of one or more of the sealing cup assemblies disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number

PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00426] An end of an expansion device assembly 4916 that defines a passage 4916a and a mounting hole 4916aa and includes an adjustable expansion device 4916b at one end, an external annular recess 4916c, a tapered external expansion surface 4916d, an internal annular recess 4916e, and a plurality of circumferentially spaced apart teeth 4916f at another end is coupled to the other end of the tubular support member 4912. In several exemplary embodiments, the adjustable expansion device 4916b may be a conventional adjustable expansion device that may include a tapered outer expansion surface whose shape, size, and/or position is adjustable, a rotary expansion device, one or more of the elements of the conventional commercially available expansion devices of Baker Hughes, Halliburton, Schlumberger, Weatherford, and/or Enventure Global Technology, L.L.C. and/or one or more of the elements of the issued patents and published patent applications assigned or licensed to Baker Hughes, Halliburton, Schlumberger, Weatherford, and/or Enventure Global Technology, L.L.C. In several exemplary embodiments, the adjustable expansion device 4916b includes one or more elements of one or more of the adjustable expansion devices disclosed in one or more of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent

application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US2004/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US2004/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or (14) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on April 15, 2004, the disclosures of which are incorporated herein by reference.

[00427] An end of a mounting pin 4918 is received within and coupled to the mounting hole 4916aa of the expansion device assembly 4916, and another of the mounting pin is received within a mounting hole 4920a defined within an expandable tubular casing 4920 that receives the tubular support member 4902, the tubular safety sub 4904, the tubular ball gripper assembly 4906, the tubular casing lock assembly 4908, the tubular tension actuator assembly 4910, the tubular support member 4912, the sealing cup assembly 4914, and the end of the expansion device assembly 4916.

[00428] In an exemplary embodiment, the expandable tubular casing 4920 is provided and includes one or more of the properties of the expandable tubulars described above with reference to Figs. 1 to 46j. In an exemplary embodiment, during the operation of the system 4900, the mounting pin 4918 permits torque to be transmitted between the expandable tubular casing 4920 and the expansion device assembly 4816. In an exemplary embodiment, the torque pin 4918 is fabricated from a drillable material such as, for example, brass or aluminum. In an exemplary embodiment, the sealing cup assembly 4914 sealingly engages the internal diameter of the expandable tubular casing 4920 during the operation of the system 4900.

[00429] An end of a tubular slotted sleeve 4921 that receives the end of the expansion device assembly 4916, including the adjustable expansion device 4916b, is coupled to an end of the expandable tubular casing 4920 and the other end of the tubular slotted sleeve includes a tapered end face 4921a. In several exemplary embodiments, the tubular slotted sleeve 4921 includes one or more perforations that may, for example, includes slots, circular holes, or other perforations.

[00430] An expandable tubular sleeve 4922 that includes a first end 4922a including a tapered external annular recess 4922aa that mates with the tapered end face 4921a of the

tubular slotted sleeve 4921, an external annular recess 4922ab spaced apart from the tapered external annular recess, an intermediate portion 4922b, and a second end 4922c having an internal threaded connection 4922d mates with and is received within the external annular recess 4916c of the expansion device assembly 4916. In an exemplary embodiment, the wall thickness of the first end 4922a of the expandable tubular sleeve 4922 is greater than the wall thickness of the second end 4922c of the expandable tubular sleeve, and the wall thickness of the intermediate portion 4922b of the expandable tubular sleeve is tapered. In an exemplary embodiment, the intermediate portion 4922b of the expandable tubular sleeve 4922 mates with and receives the external tapered surface 4916d of the expansion device assembly 4916. In an exemplary embodiment, the expandable tubular sleeve 4922 is provided and includes one or more of the properties of the expandable tubulars described above with reference to Figs. 1 to 46j.

[00431] A sealing member 4924 is received within and coupled to the external annular recess 4922ab of the first end 4922a of the expandable tubular sleeve 4922. In an exemplary embodiment, the outside diameters of the intermediate portion 4922b and the second end 4922c of the tubular sleeve 4922 are both less than or equal to the maximum outside diameter of the expandable tubular casing 4920. In an exemplary embodiment, the outside diameter of the sealing member 4924 is less than or equal to the maximum outside diameter of the expandable tubular casing 4920.

[00432] A float shoe 4926 that defines a passage 4926a having a throat 4926aa and a passage 4926b and includes an external annular recess 4926c at one end that is received within and mates with the internal annular recess 4916e of the end of the expansion device assembly 4916, a plurality of circumferentially spaced apart shoulders 4926d at another end, a plurality of circumferentially spaced apart teeth 4926e for engaging the circumferentially spaced apart teeth 4916f of the end of the expansion device assembly 4916, and a conventional float element 4926f is received within, mates with, and is coupled to the internal threaded connection 4922d of the end of the expandable tubular sleeve 4922. In an exemplary embodiment, the outside diameter of the spaced apart shoulders 4926d of the float shoe 4926 are greater than the outside diameters of both the expandable tubular casing 4920 and the expandable tubular sleeve 4922. In an exemplary embodiment, during the operation of the system 4900, the interaction of the circumferentially spaced apart teeth 4926e of the float shoe 4926 with the circumferentially spaced apart teeth 4916f of the expansion device assembly 4916 permits torque loads to be transmitted there between. In an exemplary embodiment, during the operation of the system 4900, the circumferentially spaced apart shoulders 4926d further define circumferentially spaced apart axial flow passages there between.

[00433] In an exemplary embodiment, during operation of the system 4900, as illustrated in Fig. 49a, the system is positioned within a wellbore 4928 that traverses a subterranean formation 4930. In an exemplary embodiment, during operation of the system 4900, the tubular slotted sleeve 4921 prevents debris within the wellbore 4928 from damaging the adjustable expansion device 4916b of the expansion device assembly 4916. A hardenable fluidic sealing material 4932 such as, for example, cement may then be injected into the system 4900 through the passages 4902a, 4904a, 4906a, 4908a, 4910a, 4912a, 4916a, and 4926a. The fluidic material 4932 may then be conveyed past the float element 4926f of the float shoe 4926 and through the passage 4926b into an annulus 4934 between the system 4900 and the interior surface of the wellbore 4928. The fluidic material 4932 within the annulus 4934 may then be allowed to at least partially cure.

[00434] In an exemplary embodiment, during the operation of the system 4900, as illustrated in Fig. 49b, a conventional plug 4936 is then positioned within the throat 4926aa of the passage 4926a of the float shoe 4926 by injecting fluidic material 4938 into the system 4900 through the passages 4902a, 4904a, 4906a, 4908a, 4910a, 4912a, and 4916a. As a result, the passage 4926a of the float shoe 4926 is blocked and the passages 4902a, 4904a, 4906a, 4908a, 4910a, 4912a, and 4916a may be pressurized by the continued injection of the fluidic material 4938.

[00435] In an exemplary embodiment, during the operation of the system 4900, as illustrated in Fig. 49c, the passages 4902a, 4904a, 4906a, 4908a, 4910a, 4912a and 4916a may be pressurized by the continued injection of the fluidic material 4938 into the system. As a result, the casing lock assembly 4908 is operated to engage the expandable tubular casing 4920 and the outside diameter of the adjustable expansion device 4916b of the expansion device assembly 4916 is increased. As a result, the portion of the tubular slotted sleeve 4921 that receives the adjustable expansion device 4916b is radially expanded and plastically deformed. In an exemplary embodiment, the adjustable expansion device 4916b of the expansion device assembly 4916 includes one or more external expansion surfaces 4916ba for engaging and radially expanding and plastically deforming the tubular slotted sleeve 4921 and the expandable tubular casing 4920.

[00436] In an exemplary embodiment, during the operation of the system 4900, as illustrated in Fig. 49d, the passages 4902a, 4904a, 4906a, 4908a, 4910a, 4912a and 4916a may continue to be pressurized by the continued injection of the fluidic material 4938 into the system. As a result, the casing lock assembly 4908 continues to be operated to engage the expandable tubular casing 4920 and the tension actuator assembly 4910 is operated to displace the expansion device assembly 4916, expandable tubular sleeve 4922, sealing member 4924, and float shoe 4926 upwardly in a longitudinal direction 4940 relative to the expandable tubular casing 4920 and the tubular slotted sleeve 4921. As a result, the tubular

slotted sleeve 4921 and the end of the expandable tubular casing 4920 are radially expanded and plastically deformed by the external expansion surfaces 4816ba of the adjustable expansion device 4816b of the expansion device assembly 4816. Furthermore, as a result, the tubular slotted sleeve 4921 engages the tapered end face of the shoulders 4926d of the float shoe 4926 and is thereby further radially expanded and plastically deformed. Furthermore, as a result, the radially expanded and plastically deformed end of the tubular casing 4920 receives and mates with the expandable tubular sleeve 4922 and the sealing member 4924. Furthermore, as a result, the mounting pin 4918 is sheared. In an exemplary embodiment, the end of the expandable tubular casing 4920 is radially expanded and plastically deformed by the external expansion surfaces 4916ba of the adjustable expansion device 4916b of the expansion device assembly 4916 until the end of the expandable tubular casing impacts the end faces of the shoulders 4926d of the float shoe 4926.

[00437] In an exemplary embodiment, during the operation of the system 4900, as illustrated in Fig. 49e, the passages 4902a, 4904a, 4906a, 4908a, 4910a, 4912a, and 4916a may continue to be pressurized by the continued injection of the fluidic material 4938 into the system. As a result, the casing lock assembly 4908 and the tension actuator assembly 4910 may continue to be operated in the manner described above with reference to Fig. 49d. Furthermore, as a result, the adjustable expansion device 4916b of the expansion device assembly 4916 is further displaced upwardly in the longitudinal direction 4940 relative to the expandable tubular casing 4920, and the tapered external expansion surface 4916d of the expansion device assembly is displaced upwardly relative to the expandable tubular sleeve 4922, and the sealing member 4924 in the longitudinal direction 4938. Note that the further upward displacement of the expandable tubular sleeve 4922, the sealing member 4924, and the float shoe 4926, during the continued operation of the tension actuator assembly 4910, is prevented due to the interaction between the end of the expandable tubular casing 4920 and the end faces of the shoulders 4926d of the float shoe 4926. Furthermore, as a result, the end of the expandable tubular casing 4920 is further radially expanded and plastically deformed by the external expansion surfaces 4916ba of the adjustable expansion device 4916b of the expansion device assembly 4916, and portions, 4922a and 4922b, of the expandable tubular sleeve 4922 are radially expanded and plastically deformed by the tapered external expansion surface 4916d of the expansion device assembly within the end of the expandable tubular casing. As a result, the sealing member 4924 engages and fluidicly seals the interface between the expandable tubular casing 4920 and the expandable tubular sleeve 4922. Furthermore, in an exemplary embodiment, as a result of the radial expansion and plastic deformation of the portions, 4922a and 4922b, of the expandable tubular sleeve 4922 within the end of the expandable tubular casing 4920, a metal to metal,

fluid tight seal is formed between the interior surface of the expandable tubular casing and the exterior surface of the expandable tubular sleeve. In an exemplary embodiment, once the portions, 4922a and 4922b, of the expandable tubular sleeve 4922 are completely radially expanded and plastically deformed by the tapered external expansion surface 4916d of the expansion device assembly 4916, the casing lock assembly 4908 releases the expandable tubular casing 4920.

[00438] In an exemplary embodiment, during the operation of the system 4900, as illustrated in Fig. 49f, following the release of the expandable tubular casing 4920 from the casing lock assembly 4908, the continued injection of the fluidic material 4938 into the passages of the system will further displace the adjustable expansion device 4916b of the expansion device assembly 4916 upwardly in the longitudinal direction 4940 relative to the expandable tubular casing 4920. In an exemplary embodiment, during the displacement of the adjustable expansion device 4916b of the expansion device assembly 4916 upwardly in the longitudinal direction 4940 relative to the expandable tubular casing 4920, the sealing cup assembly 4914 sealingly engage the internal surface of the expandable tubular casing 4920. As a result, the annulus within the expandable tubular casing 4920 below and proximate to the sealing cup assembly 4914 is pressurized by the injection of the fluidic material 4938 into the system 4900 thereby applying an upward axial force to the tubular support member 4912. As a result, the adjustable expansion device 4916b of the expansion device assembly 4916 is pulled through the expandable tubular casing 4920. As a result, the expandable tubular casing 4920 is further radially expanded and plastically deformed by the external expansion surfaces 4916ba of the adjustable expansion device 4916b of the expansion device assembly 4916.

[00439] In several alternative embodiments, the tension actuator assembly 4910 may be operated to radially expand and plastically deform the expandable tubular sleeve 4922 by operating the tension actuator assembly in a first stroke to radially expand and plastically deform a portion of the expandable tubular sleeve 4922. After completing the first stroke of the tension actuator assembly 4910, the casing lock assembly 4908 is operated to release the expandable tubular casing 4920, such as, for example, by reducing the operating pressure of the fluidic material 4938. The tension actuator assembly 4910 is then re-set to an initial position by displacing the tubular support member 4902, the tubular safety sub 4904, the ball gripper assembly 4906, the casing lock assembly 4908, and the portion of the tension actuator assembly rigidly coupled to the end of the casing lock assembly upwardly relative to the expandable tubular casing 4920. The operating pressure of the fluidic material 4938 is increased, and the tension actuator assembly 4910 is then operated in a second stroke to radially expand and plastically deform a further portion of the expandable tubular sleeve 4922. In several exemplary embodiments, this process may be repeated as

often as required in order to radially expand and plastically deform the desired portions of the expandable tubular sleeve 4922. In an exemplary embodiment, during the first stroke, re-setting of, and/or the second stroke of the tension actuator assembly 4910, the ball gripper assembly 4906 is also operated to limit displacement of the expandable tubular casing 4920 in one or more longitudinal directions by, for example, adjusting the operating pressure of the fluidic material 4938.

[00440] In an exemplary embodiment, the maximum outside diameter of the system 4900, during the placement of the system within the wellbore 4928, is defined by the maximum outside diameter of the expandable tubular casing 4920.

[00441] In several alternative embodiments, the system 4900 includes the ball gripper assembly 4906 and/or the casing lock assembly 4908.

[00442] In several alternative embodiments, the casing lock assembly 4908 is omitted from the system 4900. As a result, the system 4900 relies only upon the ball gripper assembly 4906 to limit displacement of the expandable tubular casing 4920.

[00443] In several exemplary embodiments of the system 4900, the operation of the ball gripper assembly 4906 and/or the casing lock assembly 4908 may be replaced with, or enhanced by, the use of conventional hydraulic or mechanical slips.

[00444] In several exemplary embodiments of the system 4900, the expandable tubular sleeve 4922 is fabricated from materials particularly suited to being removed using a drilling device such as, for example, aluminum or brass.

[00445] In several exemplary embodiments of the system 4900, the float shoe 4926 may include a sliding sleeve valve for controlling the flow of fluidic materials through the float shoe. In several exemplary embodiments of the system 4900, the end of the expansion device assembly 4916 includes a conventional stinger attached thereto for manipulating and thereby controlling the operation of the sliding sleeve valve.

[00446] In several exemplary embodiments, the sealing cup assembly 4914 may be positioned above or below the casing lock assembly 4908.

[00447] Referring to Figs. 50a, 50aa, and 50ab, an exemplary embodiment of a system 5000 for radially expanding a tubular member includes a tubular support member 5002 that defines a passage 5002a, one or more radial openings 5002b, and one or more mounting holes 5002c, and includes an internal annular recess 5002d, an internal annular recess 5002e, and an internal annular recess 5002f. An end of a tubular support member 5004 that defines a passage 5004a, a mounting hole 5004b, a radial passage 5004c, a radial passage 5004d, a radial passage 5004e, and mounting hole 5004f, and includes an external annular recess 5004g, an external annular recess 5004h, an external annular recess 5004i including external circumferentially spaced apart splines 5004j, an external threaded connection 5004k, an external threaded connection 5004l, an external flange

5004m, a tapered external flange 5004n including circumferentially spaced apart T-shaped slots 5004o, and an external flange 5004p at another end including circumferentially spaced apart teeth 5004q, is received within and mates with the internal annular recess 5002d of the tubular support member 5002. In an exemplary embodiment, the tapered external flange 5004n of the tubular support member 5004 includes a plurality of faceted surfaces 5004na.

[00448] Locking dogs 5006 that include internal spaced-apart flanges, 5006a and 5006b, external locking teeth 5006c, and spring arms, 5006d and 5006e, for biasing the locking dogs radially inwardly, are received within and mate with corresponding radial openings 5002b of the tubular support member 5002. A tubular locking dog retainer sleeve 5008 that includes external spaced-apart flanges, 5008a and 5008b, positioned in opposition to the spaced-apart flanges, 5006a and 5006b, respectively, of the locking dogs 5006 receives and mates with an end of the tubular support member 5004.

[00449] An end of an expandable tubular member 5010 that includes internal teeth 5010a for engaging the external locking teeth 5006c of the locking dogs, and an upset portion 5010b, having a locally reduced internal diameter, adjacent another end, receives and mates with the tubular support member 5002. In several exemplary embodiments, the tubular member 5010 is provided and includes one or more of the properties of the expandable tubulars described above with reference to Figs. 1 to 46j. An end of an expansion sleeve 5012 that includes an internal threaded connection 5012a at one end is coupled to the other end of the expandable tubular member 5010. In several exemplary embodiments, the expansion sleeve 5012 is fabricated from aluminum and/or brass and/or alloys of one or both and/or includes one or more of the properties of the expandable tubulars described above with reference to Figs. 1 to 46j.

[00450] An end of an emergency release tubular sleeve 5014 that defines a radial passage 5014a and includes an internal annular recess 5014b that mates with the tubular support member 5004 receives and mates with the external annular recess 5004g of the end of the tubular support member 5004. A rupture disk 5016 is positioned within and coupled to the mounting hole 5004b of the tubular support member 5004.

[00451] An end of a tubular load transfer sleeve 5018 that defines a mounting hole 5018a and includes an external flange 5018b and an internal flange 5018c, including circumferentially spaced apart internal splines 5018d that mate with the external splines 5004j of the tubular support member 5004, at another end, mates with, is coupled to, and is received within the internal annular recess 5002f of the end of the tubular support member 5002. A mounting pin 5020 is received within and coupled to the mounting hole 5002c of the tubular support member 5002 and the mounting hole 5018a of the sleeve 5018 for transmitting torque loads there between.

[00452] An upper tubular sealing cup retainer 5022 that includes an internal threaded connection 5022a that is coupled to the external threaded connection 5004k of the tubular support member 5004 and an angled end face 5022b and an external tapered flange 5022c at another end that engages the interior surface of the expandable tubular member 5010 is positioned proximate an end face of the external splines 5004j of the tubular support member 5004.

[00453] A float shoe 5024 defines a passage 5024a having a throat 5024aa and a passage 5024b and includes an external annular recess 5024c, circumferentially spaced apart teeth 5024d for engaging the circumferentially spaced apart teeth 5004q of the tubular support member 5004, an external threaded connection 5024e coupled to the internal threaded connection 5012a of the end of the expansion sleeve 5012, and a conventional float element 5024f. A lower tubular sealing cup retainer 5026 that defines a plurality of circumferentially spaced apart internal longitudinal passages 5026a includes an internal threaded connection 5026b that is coupled to the external threaded connection 5004l of the tubular support member 5004.

[00454] A lower tubular cup seal support 5028 that receives, mates with, and is coupled to the tubular support member 5004 is positioned proximate the lower tubular sealing cup retainer 5026. A lower cup seal 5030 that receives, mates with, and is coupled to the tubular support member 5004 and sealingly engages the interior surface of the expandable tubular member 5010 is positioned proximate the lower tubular sealing cup retainer 5026. A lower cup seal support 5032 receives, mates with, and is coupled to the tubular support member 5004 and receives, mates with, and supports the lower cup seal 5030. A lower back-up cup seal 5034 that receives, mates with, and is coupled to the tubular support member 5004 and sealingly engages the interior surface of the expandable tubular member 5010 receives and mates with the lower cup seal 5030 and the lower cup seal support 5032. A lower tubular cup seal support 5036 that receives, mates with, and is coupled to the tubular support member 5004 is positioned proximate to, mates with, and supports, the lower back-up cup seal 5034.

[00455] An upper tubular cup seal support 5038 that receives, mates with, and is coupled to the tubular support member 5004 is positioned proximate the lower tubular cup seal support 5036. An upper cup seal 5040 that receives, mates with, and is coupled to the tubular support member 5004 and sealingly engages the interior surface of the expandable tubular member 5010 is positioned proximate the upper tubular cup seal support 5038. An upper cup seal support 5042 receives, mates with, and is coupled to the tubular support member 5004 and receives, mates with, and supports the upper cup seal 5040. An upper back-up cup seal 5044 that receives, mates with, and is coupled to the tubular support member 5004 and sealingly engages the interior surface of the expandable tubular member

5010 receives and mates with the upper cup seal 5040 and the upper cup seal support 5042.

[00456] A tubular expansion cone retainer 5046 that defines circumferentially spaced apart internal passages 5046a that are fluidicly coupled to the circumferentially spaced apart internal longitudinal passages 5026a of the lower tubular sealing cup retainer 5026 and circumferentially spaced apart internal longitudinal passages 5046a and circumferentially spaced apart radially directed T-shaped grooves 5046b, and includes a tapered shoulder 5046c at one end and an internal annular recess 5046d that mates with and receives the external flange 5004m of the tubular support member 5004. A rupture disc 5048 is positioned within and coupled to the mounting hole 5004f of the tubular support member 5004.

[00457] Circumferentially spaced apart expansion cone segments 5050 include T-shaped mounting elements 5050a that are slidably received within and mate with corresponding T-shaped grooves 5046b of the tubular expansion cone retainer 5046 and T-shaped mounting elements 5050b that are slidably received within and mate with corresponding T-shaped slots 5004o of the tubular support member 5004. In an exemplary embodiment, each expansion cone segment 5050 is mounted upon a corresponding faceted surface 5004na of the tapered flange 5004n of the tubular support member 5004. In an exemplary embodiment, the expansion cone segments 5050 define a substantially contiguous outer expansion surface when displaced to a final radial outward position.

[00458] In an exemplary embodiment, the tubular support member 5004, the tubular expansion cone retainer 5046, and the expansion cone segments 5050 together provide an adjustable expansion device 5052. In several exemplary embodiments, the adjustable expansion device 5052, which provides expansion surfaces whose radial extent are adjustable, includes one or more elements of the adjustable expansion devices disclosed in WIPO International Publication WO 03/023178 A2, the disclosure of which is incorporated herein by reference.

[00459] In an exemplary embodiment, during operation of the system 5000, as illustrated in Figs. 50a, 50aa, and 50ab, the system is positioned within a wellbore 5054 that traverses a subterranean formation 5056. A hardenable fluidic sealing material 5058 such as, for example, cement may then be injected into the system 5000 through the passages 5002a, 5004a, and 5024a. The fluidic material 5058 may then be conveyed past the float element 5024f of the float shoe 5024 and through the passage 5024b into an annulus 5060 between the system 5000 and the interior surface of the wellbore 5054. The fluidic material 5058 within the annulus 5060 may then be allowed to at least partially cure.

[00460] In an exemplary embodiment, during the operation of the system 5000, as illustrated in Fig. 50b, a conventional plug 5062 is then positioned within the throat 5024aa of

the passage 5024a of the float shoe 5024 by injecting fluidic material 5064 into the system 5000 through the passages 5002a, 5004a, and 5024a. As a result, the passage 5024a of the float shoe 5024 is blocked and the passages 5002a and 5004a may be pressurized by the continued injection of the fluidic material 5064.

[00461] In an exemplary embodiment, during the operation of the system 5000, as illustrated in Figs. 50c, 50ca, and 50cb, the passages 5002a and 5002b may be pressurized by the continued injection of the fluidic material 5064 into the system. As a result, the rupture disc 5048 is burst thereby permitting the pressurized fluidic material 5064 to be conveyed through the radial passage 5004f of the tubular support member 5004 and into the annulus defined between the tubular support member 5004 and the tubular expansion cone retainer 5046. As a result, the expansion cone segments 5050 are displaced in a longitudinal direction 5066. As a result, because the expansion cone segments 5050 are slidably mounted for movement on the T-shaped slots 5004o of the tapered external flange 5004n of the tubular support member 5004, the expansion cone segments 5050 are also displaced outwardly in a radial direction and thereby engage and radially expand and plastically deform the expansion sleeve 5012. In an exemplary embodiment, the outward radial displacement of the expansion cone segments 5050 also radially expands and plastically deforms the expandable tubular member 5010. In this manner, the size of the adjustable expansion device 5052 is increased.

[00462] In an exemplary embodiment, during the operation of the system 5000, as illustrated in Fig. 50d, the passages 5002a and 5002b may continue to be pressurized by the continued injection of the fluidic material 5064 into the system. As a result, the pressurized fluidic material 5064 conveyed through the radial passage 5004f of the tubular support member 5004 and into the annulus defined between the tubular support member 5004 and the tubular expansion cone retainer 5046 pressurizes an annulus defined by the tubular support member 5004 and the expandable tubular member 5010 below the lower cup seal 5030. As a result, the pressurized fluidic material 5064 within the annulus defined by the tubular support member 5004 and the expandable tubular member 5010 below the lower cup seal 5030 applies a longitudinal force to the tubular support member 5004 in a direction 5068. As a result, the tubular support member 5004, the tubular sleeve 5014, and the locking dog retainer sleeve 5008 are displaced in the direction 5068 relative to the tubular support member 5002 and the locking dogs 5006 thereby releasing the flanges, 5006a and 5006b, of the locking dogs 5006 from engagement with the flanges, 5008a and 5008b, of the locking dog retainer sleeve 5008. As a result, the spring arms, 5006d and 5006e, of the locking dogs 5006 displace the locking dogs radially inward and out of locking engagement with the expandable tubular member 5010. In this manner, the tubular support member 5004 is pulled by the lower cup seal 5030 in the direction 5068 relative to the expandable tubular

member 5010. Furthermore, in this manner, a further portion of the expandable tubular member 5010 is radially expanded and plastically deformed by the adjustable expansion device 5052.

[00463] In an exemplary embodiment, during the operation of the system 5000, as illustrated in Fig. 50e, the passages 5002a and 5002b may continue to be pressurized by the continued injection of the fluidic material 5064 into the system. As a result, the pressurized fluidic material 5064 conveyed through the radial passage 5004f of the tubular support member 5004 and into the annulus defined between the tubular support member 5004 and the tubular expansion cone retainer 5046 continues to pressurize the annulus defined by the tubular support member 5004 and the expandable tubular member 5010 below the lower cup seal 5030. As a result, the pressurized fluidic material 5064 within the annulus defined by the tubular support member 5004 and the expandable tubular member 5010 below the lower cup seal 5030 continues to apply a longitudinal force to the tubular support member 5004 in the direction 5068. As a result, the tubular support member 5004 and the adjustable expansion device 5052 are displaced in the direction 5068 relative to the expandable tubular member 5010 thereby radially expanding and plastically deforming the expandable tubular member.

[00464] In an exemplary embodiment, as illustrated in Fig. 50f, following the placement of the plug 5062 within the throat 5024aa of the passage 5024a of the float shoe 5024, the expandable tubular member 5010 may be released from engagement with the locking dogs 5006. In particular, following the placement of the plug 5062 within the throat 5024aa of the passage 5024a of the float shoe 5024, the operating pressure of the injected fluidic material 5064 may be increased sufficiently to burst the rupture disk 5016 thereby permitting the fluidic material to be conveyed through the passage 5004b into the annulus defined between the tubular support member 5004 and the emergency release tubular sleeve 5014. As a result, the emergency release tubular sleeve 5014 is displaced in a direction 5070 relative to the tubular support member 5004. As a result, the locking dog retainer sleeve 5008 is displaced in the direction 5070 relative to the locking dogs 5006 thereby releasing the flanges, 5006a and 5006b, of the locking dogs 5006 from engagement with the flanges, 5008a and 5008b, of the locking dog retainer sleeve 5008. As a result, the spring arms, 5006d and 5006e, of the locking dogs 5006 displace the locking dogs radially inward and out of locking engagement with the expandable tubular member 5010. In this manner, the expandable tubular member 5010 may be controllably released from engagement with the locking dogs 5006.

[00465] In several exemplary embodiments, the tubular support member 5002 includes one or more elements of a conventional safety sub.

[00466] In several exemplary embodiments, the tubular support member 5002, the tubular support member 5004, the locking dogs 5006, and the locking dog retainer sleeve 5008 provide a locking assembly for controllably locking the expandable tubular member 5010 to the tubular support member 5002. In several exemplary embodiments, conventional casing locking tools may be substituted for, or used in addition to, the locking assembly.

[00467] In several exemplary embodiments, the lower tubular cup seal support 5028, the lower cup seal 5030, the lower cup seal support 5032, the lower back-up cup seal 5034, the lower tubular cup seal support 5036, the upper tubular cup seal support 5038, the upper cup seal 5040, the upper cup seal support 5042, and the upper back-up cup seal 5044 provide a sealing assembly for sealing the interface between the tubular support member 5004 and the expandable tubular member 5010. In this manner, an annulus is defined between the tubular support member 5004 and the expandable tubular member 5010, below the sealing assembly, that may be pressurized thereby permitting the sealing assembly to apply a tensile upward force to the tubular support member 5004. In this manner, the tubular support member 5004 may be pulled upwardly out of the expandable tubular member 5010. Furthermore, in this manner, the adjustable expansion device 5052 may be pulled upwardly through the expandable tubular member 5010 to thereby radially expand and plastically deform the expandable tubular member.

[00468] In several exemplary embodiments, the adjustable expansion device 5052 is used to expand a portion of the expandable tubular member 5010 and/or the expandable sleeve 5012, and another expansion device, which may be fixed or adjustable in size, may be used to radially expand and plastically deform the remaining portions of the expandable tubular member and/or the expandable sleeve.

[00469] In several exemplary embodiments, the expandable sleeve 5012 is fabricated from a drillable material such as, for example, aluminum or copper, and is coupled to the end of the expandable tubular member 5010 by, for example, amorphous bonding. In an exemplary embodiment, the amount of force required to radially expand the expandable sleeve 5012 is significantly less than the amount of force required to radially expand the expandable tubular member 5010. In an exemplary embodiment, following the completion of the operations described above with reference to Figs. 50a to 50e, any unexpanded portions of the expandable sleeve 5012 are removed by, for example, drilling.

[00470] In an exemplary embodiment, the float element 5024f of the float shoe 5024 is fabricated from drillable materials such as, for example, aluminum, brass, composite materials, and/or concrete in order to facilitate its subsequent removal. In an exemplary embodiment, the float shoe 5024 includes a pressure balanced sliding sleeve valve, or other equivalent valve, to permit the control of the passage of fluidic materials through the passages of the float shoe, before or after the place of the plug 5062 within the throat

5024aa of the passage 5024a of the float shoe. In this manner, the hardenable fluidic sealing material 5058 may be injected into the annulus 5060 at any point during the operation of the system 5000.

[00471] In an alternative embodiment, the locking assembly may be released from engagement with the expandable tubular member 5010 before the size of the adjustable expansion device 5052 is increased.

[00472] In an exemplary embodiment, the adjustable expansion device 5052 includes a stinger for manipulating, and thereby controlling the operation of, the float shoe 5024.

[00473] In several exemplary embodiments, following the completion of the operations described above with reference to Figs. 50a to 50c, the tubular support members, 5002 and 5004, and the adjustably expansion device 5052 are lowered relative to the expandable tubular member 5010 and expandable sleeve 5012 thereby radially expanding and plastically deforming further portions of the expandable sleeve 5012. The adjustable expansion device 5052 is then displaced upwardly relative to the expandable tubular member as described above with reference to Figs. 50d and 50e.

[00474] In several exemplary embodiments, following the completion of the operations described above with reference to Figs. 50a to 50e, the tubular support members, 5002 and 5004, and the adjustably expansion device 5052 are lowered relative to the expandable tubular member 5010 and expandable sleeve 5012 thereby radially expanding and plastically deforming further portions of the expandable sleeve 5012.

[00475] In several exemplary embodiments, the operations of Figs. 50a to 50e may be repeated by overlapping a second expandable tubular member with the expandable tubular member 5010. In this manner, a wellbore casing, including a plurality of overlapping radially expanded wellbore casings, may be provided that has a constant internal diameter.

[00476] One of the problems of the pipe material selection for expandable tubular application is an apparent contradiction or inconsistency between strength and elongation. To increase burst and collapse strength, material with higher yield strength is used. The higher yield strength generally corresponds to a decrease in the fracture toughness and correspondingly limits the extent of achievable expansion.

[00477] It is desirable to select the steel material for the tubing by balancing steel strength with amount absorbed energy measure by Charpy testing. Generally these tests are done on samples cut from tubular members. It has been found to be beneficial to cut directional samples both longitudinally oriented (aligned with the axis) and circumferentially oriented (generally perpendicular to the axis). This method of selecting samples is beneficial when both directional orientations are used yet does not completely evaluate possible and characteristic anisotropy throughout a tubular member. Moreover, for small diameter tubing

samples representative of the circumferential direction may be difficult and sometimes impossible to obtain because of the significant curvature of the tubing.

[00478] To further facilitate evaluation of a tubular member for suitability for expansion it has been found beneficial according to one aspect of the invention to consider the plastic strain ratio. One such ratio is called a Lankford value (or r-value) which is the ratio of the strains occurring in the width and thickness directions measured in a single tension test. The plastic strain ratio (r or Lankford - value) with a value of greater than 1.0 is found to be more resistant to thinning and better suited to tubular expansion. Such a Lankford value is found to be a measure of plastic anisotropy. The Lankford value (r) may be calculated by the Equation 2 below:

$$r = \frac{\ln \frac{b_o}{b_k}}{\ln \frac{L_k b_k}{l_o b_o}} \qquad \text{Equation 2}$$

where,

r - normal anisotropy coefficient

b_o & b_k - initial and final width

L_o & L_k - initial and final length

[00479] However, it is time consuming and labor intensive for this parameter to be measured using samples cut from real parts such as from the tubular members. The tubular members will have anisotropic characteristics due to crystallographic or "grain " orientation and mechanically induced differences such as impurities, inclusions, and voids, requiring multiple samples for reliably complete information. Moreover, with individual samples, only local characteristics are determined and the complete anisotropy of the tubular member may not be determinable. Further some of the tubular members have small diameters so that cutting samples oriented in a circumferential direction is not always possible. Information regarding the characteristics in the circumferential direction has been found to be important because the plastic deformation during expansion of the tubular members occurs to a very large extent in the circumferential direction,

[00480] One aspect of the present exemplary embodiments comprises the development of an improved solution for anisotropy evaluation, including a kind of plastic strain ratio similar to the Lankford parameter that is measured using real tubular members subjected to axial loading.

[00481] Fig. 51 depicts in a schematic fragmentary cross-sectional view along a plane along and through the axis 512 of a tubular member 510 that is tested with axial opposed forces 514 and 515. The tubular member 510 is axially stretched beyond the elastic limit,

through yielding and to ultimate yield or fracture. Measurements of the force and the OD and ID during the process produce test data that can be used in the formula below to produce an expandability coefficient "*f*" as set forth in Equation 1 above. Alternatively a coefficient called a formability anisotropy coefficient *F(r)* that is function of the normal anisotropy Lankford coefficient *r* may be determined as in Equation 3 below:

$$F(r) = \frac{\ln \frac{b_o}{b_k}}{\ln \frac{L_k b_k}{l_o b_o}} \qquad \text{Equation 3}$$

F(r) - formability anisotropy coefficient

b_o & b_k - initial and final tube area (inch^2)

L_o & L_k - initial and final tube length (inch)

$b = (D^2-d^2)/4$- cross section tube area.

[00482] In either circumstance, *f* or *F(r),* the use of this testing method for an entire tubular member provides useful information including anisotropic characteristics or anisotropy of the tubular member for selecting or producing beneficial tubular members for down hole expansion, similar to the use of the Lankford value for a sheet material.

[00483] Just as values for stress and strain may be plotted for solid specimen samples, as schematically depicted in Fig 52, the values for conducting a test on the tubular member may also be plotted, as depicted in Fig 53. On this basis the expansion coefficient *f* (or the formability coefficient *F(r)*) may be determined. It will be the best to measure distribution (Tensile-elongation) in longitudinal and circumferential directions simultaneously.

[00484] The foregoing expandability coefficient (or formability coefficient) is found to be useful in predicting good expansion results and may be further useful when used in combination with one or more other properties of a tubular member selected from stress-strain properties in one or more directional orientations of the material, strength & elongation, Charpy V-notch impact value in one or more directional orientations of the material, stress burst rupture, stress collapse rupture, yield strength, ductility, toughness, and strain-hardening exponent (n - value), and hardness.

[00485] In an exemplary embodiment, a tribological system is used to reduce friction and thereby minimize the expansion forces required during the radial expansion and plastic deformation of the tubular members that includes one or more of the following: (1) a tubular tribology system; (2) a drilling mud tribology system; (3) a lubrication tribology system; and (4) an expansion device tribology system.

[00486] In an exemplary embodiment, the tubular tribology system includes the application of coatings of lubricant to the interior surface of the tubular members.

[00487] In an exemplary embodiment, the drilling mud tribology system includes the addition of lubricating additives to the drilling mud.

[00488] In an exemplary embodiment, the lubrication tribology system includes the use of lubricating greases, self-lubricating expansion devices, automated injection/delivery of lubricating greases into the interface between an expansion device and the tubular members, surfaces within the interface between the expansion device and the expandable tubular member that are self-lubricating, surfaces within the interface between the expansion device and the expandable tubular member that are textured, self-lubricating surfaces within the interface between the expansion device and the expandable tubular member that include diamond and/or ceramic inserts, thermosprayed coatings, fluoropolymer coatings, PVD films, and/or CVD films.

[00489] In an exemplary embodiment, the tubular members include one or more of the following characteristics: high burst and collapse, the ability to be radially expanded more than about 40%, high fracture toughness, defect tolerance, strain recovery @ 150 F, good bending fatigue, optimal residual stresses, and corrosion resistance to H_2S in order to provide optimal characteristics during and after radial expansion and plastic deformation.

[00490] In an exemplary embodiment, the tubular members are fabricated from a steel alloy having a charpy energy of at least about 90 ft-lbs in order to provided enhanced characteristics during and after radial expansion and plastic deformation of the expandable tubular member.

[00491] In an exemplary embodiment, the tubular members are fabricated from a steel alloy having a weight percentage of carbon of less than about 0.08% in order to provide enhanced characteristics during and after radial expansion and plastic deformation of the tubular members.

[00492] In an exemplary embodiment, the tubular members are fabricated from a steel alloy having reduced sulfur content in order to minimize hydrogen induced cracking.

[00493] In an exemplary embodiment, the tubular members are fabricated from a steel alloy having a weight percentage of carbon of less than about 0.20 % and a charpy-V-notch impact toughness of at least about 6 joules in order to provide enhanced characteristics during and after radial expansion and plastic deformation of the tubular members.

[00494] In an exemplary embodiment, the tubular members are fabricated from a steel alloy having a low weight percentage of carbon in order to enhance toughness, ductility, weldability, shelf energy, and hydrogen induced cracking resistance.

[00495] In several exemplary embodiments, the tubular members are fabricated from a steel alloy having the following percentage compositions in order to provide enhanced

characteristics during and after radial expansion and plastic deformation of the tubular members:

	C	Si	Mn	P	S	Al	N	Cu	Cr	Ni	Nb	Ti	Co	Mo
EXAMPLE A	0.030	0.22	1.74	0.005	0.0005	0.028	0.0037	0.30	0.26	0.15	0.095	0.014	0.0034	
EXAMPLE B MIN	0.020	0.23	1.70	0.004	0.0005	0.026	0.0030	0.27	0.26	0.16	0.096	0.012	0.0021	
EXAMPLE B MAX	0.032	0.26	1.92	0.009	0.0010	0.035	0.0047	0.32	0.29	0.18	0.120	0.016	0.0050	
EXAMPLE C	0.028	0.24	1.77	0.007	0.0008	0.030	0.0035	0.29	0.27	0.17	0.101	0.014	0.0028	0.0020
EXAMPLE D	0.08	0.30	0.5	0.07	0.005		0.010	0.10	0.50	0.10				
EXAMPLE E	0.0028	0.009	0.17	0.011	0.006	0.027	0.0029		0.029	0.014	0.035	0.007		
EXAMPLE F	0.03	0.1	0.1	0.015	0.005					18.0		0.6	9	5
EXAMPLE G	0.002	0.01	0.15	0.07	0.005	0.04	0.0025				0.015	0.010		

[00496] In an exemplary embodiment, the ratio of the outside diameter D of the tubular members to the wall thickness t of the tubular members range from about 12 to 22 in order to enhance the collapse strength of the radially expanded and plastically deformed tubular members.

[00497] In an exemplary embodiment, the outer portion of the wall thickness of the radially expanded and plastically deformed tubular members includes tensile residual stresses in order to enhance the collapse strength following radial expansion and plastic deformation.

[00498] In several exemplary experimental embodiments, reducing residual stresses in samples of the tubular members prior to radial expansion and plastic deformation increased the collapse strength of the radially expanded and plastically deformed tubular members.

[00499] In several exemplary experimental embodiments, the collapse strength of radially expanded and plastically deformed samples of the tubulars were determined on an as-received basis, after strain aging at 250 F for 5 hours to reduce residual stresses, and after strain aging at 350 F for 14 days to reduce residual stresses as follows:

Tubular Sample	Collapse Strength After 10% Radial Expansion
Tubular Sample 1 – as received from manufacturer	4000 psi
Tubular Sample 1 – strain aged at 250 F for 5 hours to reduce residual stresses	4800 psi
Tubular Sample 1 – strain aged at 350 F for 14 days to reduce residual stresses	5000 psi

[00500] As indicated by the above table, reducing residual stresses in the tubular members, prior to radial expansion and plastic deformation, significantly increased the resulting collapse strength – post expansion.

[00501] In several exemplary experimental embodiments, the collapse strength of radially expanded and plastically deformed samples of the tubulars were determined on an as-received basis, after strain aging at 250 F for 5 hours to reduce residual stresses, and after strain aging at 350 F for 14 days to reduce residual stresses as follows:

Tubular Sample	Collapse Strength After 20% Radial Expansion
Tubular Sample 1 – as received from manufacturer	3000 psi
Tubular Sample 1 – strain aged at 250 F for 5 hours to reduce residual stresses	4000 psi
Tubular Sample 1 – strain aged at 350 F for 14 days to reduce residual stresses	4250 psi

[00502] As indicated by the above table, reducing residual stresses in the tubular members, prior to radial expansion and plastic deformation, significantly increased the resulting collapse strength – post expansion.

[00503] In an exemplary experimental embodiment, residual stresses within a tubular member were decreased from about –12,000 psi to about –6,000 psi, a reduction of about 105%. As a result, the collapse strength of the resulting tubular member was increased from about 1550 psi to about 1750 psi. This was an unexpected result.

[00504] In several exemplary experimental embodiments, tubular members were radially expanded and plastically deformed using different lubricants to achieve a range of coefficients of friction between the tubular members and a solid expansion cone during the radial expansion and plastic deformation of the tubular members. As a result, the following experimental results were obtained:

SAMPLE	COEFFICIENT OF FRICTION	EXPANSION FORCE (lbf)	WALL THICKNESS (t)	RATIO OF DIAMETER TO WALL THICKNESS AFTER EXPANSION (D/t)	COLLAPSE STRENGTH (ksi)
1	0.125	145,900	0.305	24.8	2,379
2	0.075	143,000	0.350	21.6	3,243
3	0.02	149,900	0.450	16.8	5,837
4	0.02	125,800	0.500	15.1	5,359
5	0.02	125,800	0.500	15.1	8,443

The above tabular experimental results were unexpected. In particular, the resulting collapse strength of the radially expanded and plastically deformed tubular was increased by one or more of the following: 1) reducing the coefficient of friction; and/or 2) reducing the ratio of D/t.

[00505] Referring to Fig. 54, in an exemplary experimental embodiment, a sample of steel pipe, for which the normal manufacturing process was modified to include quenching and tempering (the "Quenched and Tempered Steel Pipe No. 1"), was tested to generate a stress vs. strain curve 5400. As illustrated in Fig. 54, the yield point of the curve 5400 was 76.8 ksi. Further stress and strain testing of the Quenched and Tempered Steel Pipe No. 1, yielded the following characteristics:

Sample	Yield Strength ksi	Yield/Tensile Strength Ratio	Elongation Longitudinal % PRIOR TO FAILURE	Width Reduction % PRIOR TO FAILURE	Wall Thickness Reduction % PRIOR TO FAILURE	Anisotropy
Quenched and Tempered Steel Pipe No. 1	76.8	0.82	16%	32%	45%	0.65

The testing results for the Quenched and Tempered Steel Pipe No. 1, illustrated in Fig. 54, and summarized above in tabular form were unexpected results. Thus, the modification of the normal manufacturing process of the Quenched and Tempered Steel Pipe No. 1, to include a quenching and tempering step, significantly and unexpectedly, enhanced the performance characteristics of the pipe thereby making the pipe particularly suited to use as an expandable tubular.

[00506] Referring to Fig. 55, in an exemplary experimental embodiment, a sample of 9 5/8" steel pipe, for which the normal manufacturing process was modified to include quenching and tempering (the "Quenched and Tempered Steel Pipe No. 2"), a sample of conventional 9 5/8" NT80-HE steel pipe from Nippon Steel, and a sample of conventional 9 5/8" NT55-HE steel pipe from Nippon Steel were tested to generate stress vs. strain curves 5500, 5502, and 5504, for the Quenched and Tempered Steel Pipe No. 2, the 9 5/8" NT80-HE steel pipe from Nippon Steel, and the 9 5/8" NT55-HE steel pipe from Nippon Steel, respectively. As illustrated in Fig. 55, the yield points of the curves 5500, 5502, and 5504, were 84.4 ksi, 61.5 ksi, and 73.7 ksi, respectively. Further stress and strain testing of the Quenched and Tempered Steel Pipe No. 2, the 9 5/8" NT80-HE steel pipe from Nippon Steel, and the 9 5/8" NT55-HE steel pipe from Nippon Steel, yielded the following characteristics:

Sample	Yield Strength ksi	Yield/Tensile Strength Ratio	Elongation Longitudinal % PRIOR TO FAILURE	Width Reduction % PRIOR TO FAILURE	Wall Thickness Reduction % PRIOR TO FAILURE	Anisotropy
Quenched and Tempered Steel Pipe No. 2	84.4	0.840	20.5%	40.0%	41.8%	0.935
NT80-HE	61.5	0.62	16.5%	25.5%	47%	0.46
NT55-HE	73.7	0.67	13.5%	20.4%	37.5%	0.48

The testing results for the Quenched and Tempered Steel Pipe No. 2, illustrated in Fig. 55, and summarized above in tabular form were unexpected results. Thus, the modification of the normal manufacturing process of the Quenched and Tempered Steel Pipe No. 2, to include a quenching and tempering step, significantly and unexpectedly, enhanced the

performance characteristics of the pipe, relative to the conventional NT80-HE and NT55-HE pipes, thereby making the pipe particularly suited to use as an expandable tubular.

[00507] In an exemplary experimental embodiment, samples of steel pipe, for which the normal manufacturing process was modified to include quenching and tempering (the "Quenched and Tempered Steel Pipe Nos. 3 and 4"), were stress and strain tested and exhibited the following characteristics:

Characteristic	Value	
	Quenched and Tempered Steel Pipe No. 3	Quenched and Tempered Steel Pipe No. 4
YIELD STRENGTH	81.25 ksi	78.77 ksi
Y/T RATIO	0.829	0.822
ELONGATION PRIOR TO FAILURE	14.88%	15.90%
WIDTH REDUCTION PRIOR TO FAILURE	37.8%	44.0%
WALL THICKNESS REDUCTION PRIOR TO FAILURE	43.25%	43.33%
ANISOTROPY	0.830	1.03

The tabular experimental results presented above were unexpected.

[00508] In an exemplary experimental embodiment, samples of steel pipe, for which the normal manufacturing process was modified to include quenching and tempering (the "Quenched and Tempered Steel Pipe No. 5"), were stress and strain tested and exhibited the following characteristics:

Characteristic	Value
YIELD STRENGTH	80.19 ksi
Y/T RATIO	0.826
ELONGATION PRIOR TO FAILURE	15.25%
WIDTH REDUCTION PRIOR TO FAILURE	40.4%

Characteristic	Value
WALL THICKNESS REDUCTION PRIOR TO FAILURE	43.3%
ANISOTROPY	0.915

The tabular experimental results presented above were unexpected.

[00509] In an exemplary experimental embodiment, a sample of steel pipe, for which the normal manufacturing process was modified to include quenching and tempering (the "Quenched and Tempered Steel Pipe Nos. 6 and 7"), a sample of conventional NT80-HE steel pipe from Nippon Steel, and a sample of conventional NT55-HE steel pipe from Nippon Steel were tested to determine absorbed energy and flare expansion characteristics and exhibited the following characteristics:

Characteristic	Value			
	Quenched and Tempered Steel Pipe No. 6	Quenched and Tempered Steel Pipe No. 7	NT80-HE	NT55-HE
ABSORBED ENERGY - LONGITUDINAL	125 ft-lbs	145 ft-lbs	100 ft-lbs	50 ft-lbs
ABSORBED ENERGY - TRANSVERSE	59 ft-lbs	59 ft-lbs	40 ft-lbs	30 ft-lbs
ABSORBED ENERGY - WELD	176 ft-lbs	174 ft-lbs	70 ft-lbs	4 ft-lbs
FLARE EXPANSION	42%	52%	32%	30%

The testing results for the Quenched and Tempered Steel Pipe Nos. 6 and 7 summarized above in tabular form were unexpected results. Thus, the modification of the normal manufacturing process of the Quenched and Tempered Steel Pipe Nos. 6 and 7, to include a quenching and tempering step, significantly and unexpectedly, enhanced the performance characteristics of the pipe, relative to the conventional NT80-HE and NT55-HE pipes,

thereby making the Quenched and Tempered Pipes particularly suited to use as an expandable tubular.

[00510] In an exemplary embodiment, the flare expansion of the Quenched and Tempered Steel Pipe Nos. 6 and 7, the sample of conventional NT80-HE steel pipe from Nippon Steel, and the sample of conventional NT55-HE steel pipe from Nippon Steel were performed by pressing a tapered solid expansion cone into an end of the pipe samples to radially expand and plastically deform the ends of the pipe samples.

[00511] In an exemplary experimental embodiment, samples of steel pipe, for which the normal manufacturing process was modified to include quenching and tempering (the "Quenched and Tempered Steel Pipe No. 8"), were stress and strain tested and exhibited the following characteristics:

Characteristic	Value
YIELD STRENGTH	88.8 ksi
Y/T RATIO	0.86
ELONGATION PRIOR TO FAILURE	22%
WIDTH REDUCTION PRIOR TO FAILURE	39%
WALL THICKNESS REDUCTION PRIOR TO FAILURE	41%
ANISOTROPY	0.93

The tabular experimental results presented above were unexpected.

[00512] In an exemplary experimental embodiment, a sample of steel pipe, for which the normal manufacturing process was modified to include quenching and tempering (the "Quenched and Tempered Steel Pipe No. 9"), a sample of conventional NT80-HE steel pipe from Nippon Steel, and a sample of conventional NT55-HE steel pipe from Nippon Steel were tested to determine absorbed energy and flare expansion characteristics and exhibited the following characteristics:

Characteristic	Value		
	Quenched and Tempered Steel Pipe No. 9	NT80-HE	NT55-HE
YIELD STRENGTH	84.4 ksi	73.7 ksi	61.5 ksi

Characteristic	Value		
	Quenched and Tempered Steel Pipe No. 9	NT80-HE	NT55-HE
YIELD/TENSILE STRENGTH RATIO	0.840	0.67	0.62
ELONGATION BEFORE FAILURE	20.5%	13.5%	16.5%
WIDTH REDUCTION BEFORE FAILURE	40.0%	20.4%	25.5%
WALL THICKNESS REDUCTION BEFORE FAILURE	41.8%	37.5%	47%
ANISOTROPY	0.935	0.48	0.46

The testing results for the Quenched and Tempered Steel Pipe No. 9 summarized above in tabular form were unexpected results. Thus, the modification of the normal manufacturing process of the Quenched and Tempered Steel Pipe No. 9, to include a quenching and tempering step, significantly and unexpectedly, enhanced the performance characteristics of the pipe, relative to the conventional NT80-HE and NT55-HE pipes, thereby making the Quenched and Tempered Pipes particularly suited to use as an expandable tubular.

[00513] In an exemplary experimental embodiment, samples of steel pipe, for which the normal manufacturing process was modified to include quenching and tempering (the "Quenched and Tempered Steel Pipe No. 10"), were stress and strain tested and exhibited the following characteristics:

Characteristic	Value
YIELD STRENGTH	84.6 ksi
Y/T RATIO	0.85
ELONGATION PRIOR TO FAILURE	21%
WIDTH REDUCTION PRIOR TO FAILURE	39%
WALL THICKNESS REDUCTION PRIOR TO FAILURE	43%
ANISOTROPY	0.88

The tabular experimental results presented above were unexpected.

[00514] In an exemplary embodiment, the composition of the Quench and Temper Steel Pipe Nos. 1 to 10 included the following weight percentages:

C	Si	Mn	P	S	Cu	Cr	Ni
0.27	0.14	1.28	0.009	0.005		0.14	

In an exemplary embodiment, the quenching of the Quench and Temper Steel Pipe Nos. 1 to 10 was provided at 970 C, and the tempering of the Quench and Temper Steel Pipe Nos. 1 to 10 was provided for 10 minutes at 670 C.

[00515] In an exemplary embodiment, using a combination of empirical, theoretical, and experimental data, electrical resistance pipe ("ERW") tubular members most suitable for radial expansion and plastic deformation exhibit the following characteristics:

Characteristic	Value
ABSORBED ENERGY IN THE LONGITUDINAL DIRECTION	at least 80 ft-lb
ABSORBED ENERGY IN THE TRANSVERSE DIRECTION	at least 60 ft-lb
ABSORBED ENERGY IN THE TRANSVERSE WELD AREA	at least 60 ft-lb
FLARE EXPANSION	45% to 75% MINIMUM W/O CRACKS
TENSILE STRENGTH	60 TO 120 ksi
YIELD STRENGTH	40 TO 100 ksi
Y/T RATIO	40% to 85% MAXIMUM
LONGITUDINAL ELONGATION PRIOR TO FAILURE	A MINIMUM OF 22% to 35%
WIDTH REDUCTION PRIOR TO FAILURE	A MINIMUM OF 30% to 45%
WALL THICKNESS REDUCTION PRIOR TO FAILURE	A MINIMUM OF 30% to 45%
ANISOTROPY	A MINIMUM OF 0.8 to 1.5

[00516] In an exemplary experimental embodiment, based upon theoretical, empirical, and experimental data, tubular members that exhibit the following characteristics are best suited for radial expansion and plastic deformation:

Characteristic	Value
YIELD STRENGTH	50 to 95 ksi

Characteristic	Value
Y/T RATIO	less than 0.5 to 0.82
ELONGATION PRIOR TO FAILURE	greater than 16 to 30 %
WIDTH REDUCTION PRIOR TO FAILURE	greater than 32 to 45%
WALL THICKNESS REDUCTION PRIOR TO FAILURE	greater than 30 to 45%
ANISOTROPY	greater than 0.65 to 1.5

[00517] In an exemplary embodiment, as illustrated in Figs. 56 and 57, in an exemplary embodiment, a method 5600 of processing tubular members is implemented in which, in step 5602, a manufactured tubular member 5602a is received. In step 5604, the manufactured tubular member 5602a is then cold rolled to provide a cold-rolled tubular member 5604a. In step 5606, the cold-rolled tubular member 5604a is then inter critical annealed to provide an annealed tubular member 5606a. In step 5608, the annealed tubular member 5606a is then positioned within a wellbore and radially expanded and plastically deformed in a conventional manner to provide a radially expanded and plastically deformed tubular member 5608a. In step 5610, the radially expanded and plastically deformed tubular member 5608a is then baked within the wellbore, using the ambient temperatures within the wellbore, to provide an after-baked tubular member 5610a. As illustrated in Fig. 57, the ultimate and final yield strength of the after-baked tubular member 5610a is greater than the yield strength of the manufactured tubular member 5602a. In an exemplary embodiment, the manufactured tubular member 5602a is a dual phase steel pipe or a Transformation Induced Plasticity ("TRIP") steel pipe.

[00518] In an exemplary embodiment, the dual phase steel manufactured pipe 5602a includes a microstructure having about 15% to 30% martensite and ferrite. In an exemplary embodiment, the dual phase steel manufactured pipe 10502a includes a composition of 0.1% C, 1.2% Mn, and 0.3% Si.

[00519] In an exemplary embodiment, as illustrated in Fig. 58, when the manufactured pipe 5602a is a dual phase steel, the initial microstructure of the pipe includes ferrite and pearlite. In an exemplary embodiment, in step 5606, the intercritical annealing of the cold rolled pipe 5604a is performed at about 750 C. As a result of the intercritical annealing, at least some of the pearlite is converted to austentite. Following the completion of the intercritical annealing in step 5606, the annealed pipe 5606a is allowed to cool. As a result

of the cooling, at least some of the austentite in the annealed pipe 5606a is converted to martensite. In an exemplary embodiment, in step 5610, the baking of the radially expanded and plastically deformed pipe 5608a is provided within the wellbore at temperatures ranging from about 100 C to 250 C. In an exemplary embodiment, as a result of the baking step 5610, the radially expanded and plastically deformed pipe 10508a is stress-relieved and bake hardened.

[00520] In an exemplary embodiment, in step 5604 of the method 5600, as illustrated in Fig. 59, the temperature of the manufactured steel pipe 5602a follows a curve 5902 in which the steel pipe is deformed throughout the cooling progression of the curve at a plurality of separate stages, 5902a and 5902b. In an exemplary embodiment, during the first pipe rolling stage 5902a, insoluble precipitates within the pipe 5602a retard austentite growth and the deformation also promotes precipitation. In an exemplary embodiment, during the second pipe rolling state 5902b, insoluble precipitates within the pipe 5602a inhibit recrystallization and austentite grains are conditioned. As a result, the ultimate yield and collapse strength of the baked pipe 5610a is enhanced.

[00521] A method of forming a tubular liner within a preexisting structure has been described that includes positioning a tubular assembly within the preexisting structure; and radially expanding and plastically deforming the tubular assembly within the preexisting structure, wherein, prior to the radial expansion and plastic deformation of the tubular assembly, a predetermined portion of the tubular assembly has a lower yield point than another portion of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a larger inside diameter after the radial expansion and plastic deformation than other portions of the tubular assembly. In an exemplary embodiment, the method further includes positioning another tubular assembly within the preexisting structure in overlapping relation to the tubular assembly; and radially expanding and plastically deforming the other tubular assembly within the preexisting structure, wherein, prior to the radial expansion and plastic deformation of the tubular assembly, a predetermined portion of the other tubular assembly has a lower yield point than another portion of the other tubular assembly. In an exemplary embodiment, the inside diameter of the radially expanded and plastically deformed other

portion of the tubular assembly is equal to the inside diameter of the radially expanded and plastically deformed other portion of the other tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly includes an end portion of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a plurality of predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a plurality of spaced apart predetermined portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly includes an end portion of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly includes a plurality of other portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly includes a plurality of spaced apart other portions of the tubular assembly. In an exemplary embodiment, the tubular assembly includes a plurality of tubular members coupled to one another by corresponding tubular couplings. In an exemplary embodiment, the tubular couplings include the predetermined portions of the tubular assembly; and wherein the tubular members comprise the other portion of the tubular assembly. In an exemplary embodiment, one or more of the tubular couplings include the predetermined portions of the tubular assembly. In an exemplary embodiment, one or more of the tubular members include the predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly defines one or more openings. In an exemplary embodiment, one or more of the openings include slots. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary embodiment, the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1; and the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the predetermined portion of the tubular assembly is a first steel alloy including: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and the yield point of the predetermined portion of the tubular assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of

the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.48. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a second steel alloy including: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and the yield point of the predetermined portion of the tubular assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.04. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a third steel alloy including: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.92. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a fourth steel alloy including: 0.02 % C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.34. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.48. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and the yield point of the predetermined portion of the tubular assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an

exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.04. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.92. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.34. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, ranges from about 1.04 to about 1.92. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is greater than 0.12. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly is greater than the expandability coefficient of the other portion of the tubular assembly. In an exemplary embodiment, the tubular assembly includes a wellbore casing, a pipeline, or a structural support. In an exemplary embodiment, the carbon content of the predetermined portion of the tubular assembly is less than or equal to 0.12 percent; and wherein the carbon equivalent value for the predetermined portion of the tubular assembly is less than 0.21. In an exemplary embodiment, the carbon content of the predetermined portion of the tubular assembly is greater than 0.12 percent; and wherein the carbon equivalent value for the predetermined portion of the tubular assembly is less than 0.36. In an exemplary embodiment, a yield point of an inner tubular portion of at least a portion of the tubular assembly is less than a yield point of an outer tubular portion of the portion of the tubular assembly. In an exemplary embodiment, yield point of the inner tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in an linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in an non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies in an linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies in an non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies as a function of the radial position within the tubular body; and wherein the yield

point of the outer tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the rate of change of the yield point of the inner tubular portion of the tubular body is different than the rate of change of the yield point of the outer tubular portion of the tubular body. In an exemplary embodiment, the rate of change of the yield point of the inner tubular portion of the tubular body is different than the rate of change of the yield point of the outer tubular portion of the tubular body. In an exemplary embodiment, prior to the radial expansion and plastic deformation, at least a portion of the tubular assembly comprises a microstructure comprising a hard phase structure and a soft phase structure. In an exemplary embodiment, prior to the radial expansion and plastic deformation, at least a portion of the tubular assembly comprises a microstructure comprising a transitional phase structure. In an exemplary embodiment, the hard phase structure comprises martensite. In an exemplary embodiment, the soft phase structure comprises ferrite. In an exemplary embodiment, the transitional phase structure comprises retained austentite. In an exemplary embodiment, the hard phase structure comprises martensite; wherein the soft phase structure comprises ferrite; and wherein the transitional phase structure comprises retained austentite. In an exemplary embodiment, the portion of the tubular assembly comprising a microstructure comprising a hard phase structure and a soft phase structure comprises, by weight percentage, about 0.1% C, about 1.2% Mn, and about 0.3% Si.

[00522] An expandable tubular member has been described that includes a steel alloy including: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, a yield point of the tubular member is at most

about 46.9 ksi prior to a radial expansion and plastic deformation; and a yield point of the tubular member is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the tubular member after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the tubular member prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the tubular member, prior to a radial expansion and plastic deformation, is about 1.48. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00523] An expandable tubular member has been described that includes a steel alloy including: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, a yield point of the tubular member is at most about 57.8 ksi prior to a radial expansion and plastic deformation; and the yield point of the tubular member is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, a yield point of the of the tubular member after a radial expansion and plastic deformation is at least about 28 % greater than the yield point of the tubular member prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the tubular member, prior to a radial expansion and plastic deformation, is about 1.04. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00524] An expandable tubular member has been described that includes a steel alloy including: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the tubular member, prior to a radial expansion and plastic deformation, is about 1.92. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00525] An expandable tubular member has been described that includes a steel alloy including: 0.02 % C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary embodiment, the anisotropy of the tubular member, prior to a radial expansion and plastic deformation, is about 1.34. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00526] An expandable tubular member has been described, wherein the yield point of the expandable tubular member is at most about 46.9 ksi prior to a radial expansion and plastic deformation; and wherein the yield point of the expandable tubular member is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00527] An expandable tubular member has been described, wherein a yield point of the expandable tubular member after a radial expansion and plastic deformation is at least about

40 % greater than the yield point of the expandable tubular member prior to the radial expansion and plastic deformation. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00528] An expandable tubular member has been described, wherein the anisotropy of the expandable tubular member, prior to the radial expansion and plastic deformation, is at least about 1.48. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00529] An expandable tubular member has been described, wherein the yield point of the expandable tubular member is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the expandable tubular member is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00530] An expandable tubular member has been described, wherein the yield point of the expandable tubular member after a radial expansion and plastic deformation is at least about 28 % greater than the yield point of the expandable tubular member prior to the radial expansion and plastic deformation. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00531] An expandable tubular member has been described, wherein the anisotropy of the expandable tubular member, prior to the radial expansion and plastic deformation, is at least about 1.04. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00532] An expandable tubular member has been described, wherein the anisotropy of the expandable tubular member, prior to the radial expansion and plastic deformation, is at least about 1.92. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00533] An expandable tubular member has been described, wherein the anisotropy of the expandable tubular member, prior to the radial expansion and plastic deformation, is at least about 1.34. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00534] An expandable tubular member has been described, wherein the anisotropy of the expandable tubular member, prior to the radial expansion and plastic deformation, ranges from about 1.04 to about 1.92. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00535] An expandable tubular member has been described, wherein the yield point of the expandable tubular member, prior to the radial expansion and plastic deformation, ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the tubular

member includes a wellbore casing, a pipeline, or a structural support.

[00536] An expandable tubular member has been described, wherein the expandability coefficient of the expandable tubular member, prior to the radial expansion and plastic deformation, is greater than 0.12. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00537] An expandable tubular member has been described, wherein the expandability coefficient of the expandable tubular member is greater than the expandability coefficient of another portion of the expandable tubular member. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00538] An expandable tubular member has been described, wherein the tubular member has a higher ductility and a lower yield point prior to a radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00539] A method of radially expanding and plastically deforming a tubular assembly including a first tubular member coupled to a second tubular member has been described that includes radially expanding and plastically deforming the tubular assembly within a preexisting structure; and using less power to radially expand each unit length of the first tubular member than to radially expand each unit length of the second tubular member. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00540] A system for radially expanding and plastically deforming a tubular assembly including a first tubular member coupled to a second tubular member has been described that includes means for radially expanding the tubular assembly within a preexisting structure; and means for using less power to radially expand each unit length of the first tubular member than required to radially expand each unit length of the second tubular member. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00541] A method of manufacturing a tubular member has been described that includes processing a tubular member until the tubular member is characterized by one or more intermediate characteristics; positioning the tubular member within a preexisting structure; and processing the tubular member within the preexisting structure until the tubular member is characterized one or more final characteristics. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support. In an exemplary embodiment, the preexisting structure includes a wellbore that traverses a subterranean formation. In an exemplary embodiment, the characteristics are selected from a group consisting of yield point and ductility. In an exemplary embodiment, processing the tubular

member within the preexisting structure until the tubular member is characterized one or more final characteristics includes: radially expanding and plastically deforming the tubular member within the preexisting structure.

[00542] An apparatus has been described that includes an expandable tubular assembly; and an expansion device coupled to the expandable tubular assembly; wherein a predetermined portion of the expandable tubular assembly has a lower yield point than another portion of the expandable tubular assembly. In an exemplary embodiment, the expansion device includes a rotary expansion device, an axially displaceable expansion device, a reciprocating expansion device, a hydroforming expansion device, and/or an impulsive force expansion device. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility and a lower yield point than another portion of the expandable tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility than another portion of the expandable tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly has a lower yield point than another portion of the expandable tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly includes an end portion of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a plurality of predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a plurality of spaced apart predetermined portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly includes an end portion of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly includes a plurality of other portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly includes a plurality of spaced apart other portions of the tubular assembly. In an exemplary embodiment, the tubular assembly includes a plurality of tubular members coupled to one another by corresponding tubular couplings. In an exemplary embodiment, the tubular couplings comprise the predetermined portions of the tubular assembly; and wherein the tubular members comprise the other portion of the tubular assembly. In an exemplary embodiment, one or more of the tubular couplings comprise the predetermined portions of the tubular assembly. In an exemplary embodiment, one or more of the tubular members comprise the predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly defines one or more openings. In an exemplary embodiment, one or more of the openings comprise slots. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1 In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary embodiment, the strain hardening exponent for the predetermined portion of the tubular

assembly is greater than 0.12. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1; and wherein the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a first steel alloy including: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly is about 1.48. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a second steel alloy including: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly is about 1.04. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a third steel alloy including: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly is about 1.92. In an exemplary embodiment, the predetermined portion of the tubular assembly includes a fourth steel alloy including: 0.02 % C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly is at least about 1.34. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly is at least about 1.48. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly is at least about 1.04. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly is at least about 1.92. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly is at least about 1.34. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly ranges from about 1.04 to about 1.92. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly is greater than the expandability coefficient of the other portion of the tubular assembly. In an exemplary embodiment, the tubular assembly includes a wellbore casing, a pipeline, or a structural support. In an exemplary embodiment,

the carbon content of the predetermined portion of the tubular assembly is less than or equal to 0.12 percent; and wherein the carbon equivalent value for the predetermined portion of the tubular assembly is less than 0.21. In an exemplary embodiment, the carbon content of the predetermined portion of the tubular assembly is greater than 0.12 percent; and wherein the carbon equivalent value for the predetermined portion of the tubular assembly is less than 0.36. In an exemplary embodiment, a yield point of an inner tubular portion of at least a portion of the tubular assembly is less than a yield point of an outer tubular portion of the portion of the tubular assembly. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in an linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in an non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies in an linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies in an non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the

tubular body. In an exemplary embodiment, the rate of change of the yield point of the inner tubular portion of the tubular body is different than the rate of change of the yield point of the outer tubular portion of the tubular body. In an exemplary embodiment, the rate of change of the yield point of the inner tubular portion of the tubular body is different than the rate of change of the yield point of the outer tubular portion of the tubular body. In an exemplary embodiment, at least a portion of the tubular assembly comprises a microstructure comprising a hard phase structure and a soft phase structure. In an exemplary embodiment, prior to the radial expansion and plastic deformation, at least a portion of the tubular assembly comprises a microstructure comprising a transitional phase structure. In an exemplary embodiment, wherein the hard phase structure comprises martensite. In an exemplary embodiment, wherein the soft phase structure comprises ferrite. In an exemplary embodiment, wherein the transitional phase structure comprises retained austentite. In an exemplary embodiment, the hard phase structure comprises martensite; wherein the soft phase structure comprises ferrite; and wherein the transitional phase structure comprises retained austentite. In an exemplary embodiment, the portion of the tubular assembly comprising a microstructure comprising a hard phase structure and a soft phase structure comprises, by weight percentage, about 0.1% C, about 1.2% Mn, and about 0.3% Si. In an exemplary embodiment, at least a portion of the tubular assembly comprises a microstructure comprising a hard phase structure and a soft phase structure. In an exemplary embodiment, the portion of the tubular assembly comprises, by weight percentage, 0.065% C, 1.44% Mn, 0.01% P, 0.002% S, 0.24% Si, 0.01% Cu, 0.01% Ni, 0.02% Cr, 0.05% V, 0.01% Mo, 0.01% Nb, and 0.01%Ti. In an exemplary embodiment, the portion of the tubular assembly comprises, by weight percentage, 0.18% C, 1.28% Mn, 0.017% P, 0.004% S, 0.29% Si, 0.01% Cu, 0.01% Ni, 0.03% Cr, 0.04% V, 0.01% Mo, 0.03% Nb, and 0.01%Ti. In an exemplary embodiment, the portion of the tubular assembly comprises, by weight percentage, 0.08% C, 0.82% Mn, 0.006% P, 0.003% S, 0.30% Si, 0.06% Cu, 0.05% Ni, 0.05% Cr, 0.03% V, 0.03% Mo, 0.01% Nb, and 0.01%Ti. In an exemplary embodiment, the portion of the tubular assembly comprises a microstructure comprising one or more of the following: martensite, pearlite, vanadium carbide, nickel carbide, or titanium carbide. In an exemplary embodiment, the portion of the tubular assembly comprises a microstructure comprising one or more of the following: pearlite or pearlite striation. In an exemplary embodiment, the portion of the tubular assembly comprises a microstructure comprising one or more of the following: grain pearlite, widmanstatten martensite, vanadium carbide, nickel carbide, or titanium carbide. In an exemplary embodiment, the portion of the tubular assembly comprises a microstructure comprising one or more of the following: ferrite, grain pearlite, or martensite. In an exemplary embodiment, the portion of the tubular assembly comprises a microstructure

comprising one or more of the following: ferrite, martensite, or bainite. In an exemplary embodiment, the portion of the tubular assembly comprises a microstructure comprising one or more of the following: bainite, pearlite, or ferrite. In an exemplary embodiment, the portion of the tubular assembly comprises a yield strength of about 67ksi and a tensile strength of about 95 ksi. In an exemplary embodiment, the portion of the tubular assembly comprises a yield strength of about 82 ksi and a tensile strength of about 130 ksi. In an exemplary embodiment, the portion of the tubular assembly comprises a yield strength of about 60 ksi and a tensile strength of about 97 ksi.

[00543] An expandable tubular member has been described, wherein a yield point of the expandable tubular member after a radial expansion and plastic deformation is at least about 5.8 % greater than the yield point of the expandable tubular member prior to the radial expansion and plastic deformation. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00544] A method of determining the expandability of a selected tubular member has been described that includes determining an anisotropy value for the selected tubular member, determining a strain hardening value for the selected tubular member; and multiplying the anisotropy value times the strain hardening value to generate an expandability value for the selected tubular member. In an exemplary embodiment, an anisotropy value greater than 0.12 indicates that the tubular member is suitable for radial expansion and plastic deformation. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support.

[00545] A method of radially expanding and plastically deforming tubular members has been described that includes selecting a tubular member; determining an anisotropy value for the selected tubular member; determining a strain hardening value for the selected tubular member; multiplying the anisotropy value times the strain hardening value to generate an expandability value for the selected tubular member; and if the anisotropy value is greater than 0.12, then radially expanding and plastically deforming the selected tubular member. In an exemplary embodiment, the tubular member includes a wellbore casing, a pipeline, or a structural support. In an exemplary embodiment, radially expanding and plastically deforming the selected tubular member includes: inserting the selected tubular member into a preexisting structure; and then radially expanding and plastically deforming the selected tubular member. In an exemplary embodiment, the preexisting structure includes a wellbore that traverses a subterranean formation.

[00546] A radially expandable multiple tubular member apparatus has been described that includes a first tubular member; a second tubular member engaged with the first tubular member forming a joint; a sleeve overlapping and coupling the first and second tubular members at the joint; the sleeve having opposite tapered ends and a flange engaged in a

recess formed in an adjacent tubular member; and one of the tapered ends being a surface formed on the flange. In an exemplary embodiment, the recess includes a tapered wall in mating engagement with the tapered end formed on the flange. In an exemplary embodiment, the sleeve includes a flange at each tapered end and each tapered end is formed on a respective flange. In an exemplary embodiment, each tubular member includes a recess. In an exemplary embodiment, each flange is engaged in a respective one of the recesses. In an exemplary embodiment, each recess includes a tapered wall in mating engagement with the tapered end formed on a respective one of the flanges.

[00547] A method of joining radially expandable multiple tubular members has also been described that includes providing a first tubular member; engaging a second tubular member with the first tubular member to form a joint; providing a sleeve having opposite tapered ends and a flange, one of the tapered ends being a surface formed on the flange; and mounting the sleeve for overlapping and coupling the first and second tubular members at the joint, wherein the flange is engaged in a recess formed in an adjacent one of the tubular members. In an exemplary embodiment, the method further includes providing a tapered wall in the recess for mating engagement with the tapered end formed on the flange. In an exemplary embodiment, the method further includes providing a flange at each tapered end wherein each tapered end is formed on a respective flange. In an exemplary embodiment, the method further includes providing a recess in each tubular member. In an exemplary embodiment, the method further includes engaging each flange in a respective one of the recesses. In an exemplary embodiment, the method further includes providing a tapered wall in each recess for mating engagement with the tapered end formed on a respective one of the flanges.

[00548] A radially expandable multiple tubular member apparatus has been described that includes a first tubular member; a second tubular member engaged with the first tubular member forming a joint; and a sleeve overlapping and coupling the first and second tubular members at the joint; wherein at least a portion of the sleeve is comprised of a frangible material.

[00549] A radially expandable multiple tubular member apparatus has been described that includes a first tubular member; a second tubular member engaged with the first tubular member forming a joint; and a sleeve overlapping and coupling the first and second tubular members at the joint; wherein the wall thickness of the sleeve is variable.

[00550] A method of joining radially expandable multiple tubular members has been described that includes providing a first tubular member; engaging a second tubular member with the first tubular member to form a joint; providing a sleeve comprising a frangible material; and mounting the sleeve for overlapping and coupling the first and second tubular members at the joint.

[00551] A method of joining radially expandable multiple tubular members has been described that includes providing a first tubular member; engaging a second tubular member with the first tubular member to form a joint; providing a sleeve comprising a variable wall thickness; and mounting the sleeve for overlapping and coupling the first and second tubular members at the joint.

[00552] An expandable tubular assembly has been described that includes a first tubular member; a second tubular member coupled to the first tubular member; and means for increasing the axial compression loading capacity of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members.

[00553] An expandable tubular assembly has been described that includes a first tubular member; a second tubular member coupled to the first tubular member; and means for increasing the axial tension loading capacity of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members.

[00554] An expandable tubular assembly has been described that includes a first tubular member; a second tubular member coupled to the first tubular member; and means for increasing the axial compression and tension loading capacity of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members.

[00555] An expandable tubular assembly has been described that includes a first tubular member; a second tubular member coupled to the first tubular member; and means for avoiding stress risers in the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members.

[00556] An expandable tubular assembly has been described that includes a first tubular member; a second tubular member coupled to the first tubular member; and means for inducing stresses at selected portions of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members.

[00557] In several exemplary embodiments of the apparatus described above, the sleeve is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed.

[00558] In several exemplary embodiments of the method described above, the method further includes maintaining the sleeve in circumferential tension; and maintaining the first and second tubular members in circumferential compression before, during, and/or after the radial expansion and plastic deformation of the first and second tubular members.

[00559] An expandable tubular assembly has been described that includes a first tubular member, a second tubular member coupled to the first tubular member, a first threaded connection for coupling a portion of the first and second tubular members, a second threaded connection spaced apart from the first threaded connection for coupling another portion of the first and second tubular members, a tubular sleeve coupled to and receiving end portions of the first and second tubular members, and a sealing element positioned between the first and second spaced apart threaded connections for sealing an interface between the first and second tubular member, wherein the sealing element is positioned within an annulus defined between the first and second tubular members. In an exemplary embodiment, the annulus is at least partially defined by an irregular surface. In an exemplary embodiment, the annulus is at least partially defined by a toothed surface. In an exemplary embodiment, the sealing element comprises an elastomeric material. In an exemplary embodiment, the sealing element comprises a metallic material. In an exemplary embodiment, the sealing element comprises an elastomeric and a metallic material.

[00560] A method of joining radially expandable multiple tubular members has been described that includes providing a first tubular member, providing a second tubular member, providing a sleeve, mounting the sleeve for overlapping and coupling the first and second tubular members, threadably coupling the first and second tubular members at a first location, threadably coupling the first and second tubular members at a second location spaced apart from the first location, and sealing an interface between the first and second tubular members between the first and second locations using a compressible sealing element. In an exemplary embodiment, the sealing element includes an irregular surface. In an exemplary embodiment, the sealing element includes a toothed surface. In an exemplary embodiment, the sealing element comprises an elastomeric material. In an exemplary embodiment, the sealing element comprises a metallic material. In an exemplary embodiment, the sealing element comprises an elastomeric and a metallic material.

[00561] An expandable tubular assembly has been described that includes a first tubular member, a second tubular member coupled to the first tubular member, a first threaded connection for coupling a portion of the first and second tubular members, a second threaded connection spaced apart from the first threaded connection for coupling another portion of the first and second tubular members, and a plurality of spaced apart tubular sleeves coupled to and receiving end portions of the first and second tubular members. In an exemplary embodiment, at least one of the tubular sleeves is positioned in opposing relation to the first threaded connection; and wherein at least one of the tubular sleeves is positioned in opposing relation to the second threaded connection. In an exemplary embodiment, at least one of the tubular sleeves is not positioned in opposing relation to the first and second threaded connections.

[00562] A method of joining radially expandable multiple tubular members has been described that includes providing a first tubular member, providing a second tubular member, threadably coupling the first and second tubular members at a first location, threadably coupling the first and second tubular members at a second location spaced apart from the first location, providing a plurality of sleeves, and mounting the sleeves at spaced apart locations for overlapping and coupling the first and second tubular members. In an exemplary embodiment, at least one of the tubular sleeves is positioned in opposing relation to the first threaded coupling; and wherein at least one of the tubular sleeves is positioned in opposing relation to the second threaded coupling. In an exemplary embodiment, at least one of the tubular sleeves is not positioned in opposing relation to the first and second threaded couplings.

[00563] An expandable tubular assembly has been described that includes a first tubular member, a second tubular member coupled to the first tubular member, and a plurality of spaced apart tubular sleeves coupled to and receiving end portions of the first and second tubular members.

[00564] A method of joining radially expandable multiple tubular members has been described that includes providing a first tubular member, providing a second tubular member, providing a plurality of sleeves, coupling the first and second tubular members, and mounting the sleeves at spaced apart locations for overlapping and coupling the first and second tubular members.

[00565] An expandable tubular assembly has been described that includes a first tubular member, a second tubular member coupled to the first tubular member, a threaded connection for coupling a portion of the first and second tubular members, and a tubular sleeves coupled to and receiving end portions of the first and second tubular members, wherein at least a portion of the threaded connection is upset. In an exemplary embodiment, at least a portion of tubular sleeve penetrates the first tubular member.

[00566] A method of joining radially expandable multiple tubular members has been described that includes providing a first tubular member, providing a second tubular member, threadably coupling the first and second tubular members, and upsetting the threaded coupling. In an exemplary embodiment, the first tubular member further comprises an annular extension extending therefrom, and the flange of the sleeve defines an annular recess for receiving and mating with the annular extension of the first tubular member. In an exemplary embodiment, the first tubular member further comprises an annular extension extending therefrom; and the flange of the sleeve defines an annular recess for receiving and mating with the annular extension of the first tubular member.

[00567] A radially expandable multiple tubular member apparatus has been described that includes a first tubular member, a second tubular member engaged with the first tubular

member forming a joint, a sleeve overlapping and coupling the first and second tubular members at the joint, and one or more stress concentrators for concentrating stresses in the joint. In an exemplary embodiment, one or more of the stress concentrators comprises one or more external grooves defined in the first tubular member. In an exemplary embodiment, one or more of the stress concentrators comprises one or more internal grooves defined in the second tubular member. In an exemplary embodiment, one or more of the stress concentrators comprises one or more openings defined in the sleeve. In an exemplary embodiment, one or more of the stress concentrators comprises one or more external grooves defined in the first tubular member; and one or more of the stress concentrators comprises one or more internal grooves defined in the second tubular member. In an exemplary embodiment, one or more of the stress concentrators comprises one or more external grooves defined in the first tubular member; and one or more of the stress concentrators comprises one or more openings defined in the sleeve. In an exemplary embodiment, one or more of the stress concentrators comprises one or more internal grooves defined in the second tubular member; and one or more of the stress concentrators comprises one or more openings defined in the sleeve. In an exemplary embodiment, one or more of the stress concentrators comprises one or more external grooves defined in the first tubular member; wherein one or more of the stress concentrators comprises one or more internal grooves defined in the second tubular member; and wherein one or more of the stress concentrators comprises one or more openings defined in the sleeve.

[00568] A method of joining radially expandable multiple tubular members has been described that includes providing a first tubular member, engaging a second tubular member with the first tubular member to form a joint, providing a sleeve having opposite tapered ends and a flange, one of the tapered ends being a surface formed on the flange, and concentrating stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the first tubular member to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the second tubular member to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the sleeve to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the first tubular member and the second tubular member to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the first tubular member and the sleeve to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the second tubular member and the sleeve to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint

comprises using the first tubular member, the second tubular member, and the sleeve to concentrate stresses within the joint.

[00569] A system for radially expanding and plastically deforming a first tubular member coupled to a second tubular member by a mechanical connection has been described that includes means for radially expanding the first and second tubular members, and means for maintaining portions of the first and second tubular member in circumferential compression following the radial expansion and plastic deformation of the first and second tubular members.

[00570] A system for radially expanding and plastically deforming a first tubular member coupled to a second tubular member by a mechanical connection has been described that includes means for radially expanding the first and second tubular members; and means for concentrating stresses within the mechanical connection during the radial expansion and plastic deformation of the first and second tubular members.

[00571] A system for radially expanding and plastically deforming a first tubular member coupled to a second tubular member by a mechanical connection has been described that includes means for radially expanding the first and second tubular members; means for maintaining portions of the first and second tubular member in circumferential compression following the radial expansion and plastic deformation of the first and second tubular members; and means for concentrating stresses within the mechanical connection during the radial expansion and plastic deformation of the first and second tubular members.

[00572] A radially expandable tubular member apparatus has been described that includes a first tubular member; a second tubular member engaged with the first tubular member forming a joint; and a sleeve overlapping and coupling the first and second tubular members at the joint; wherein, prior to a radial expansion and plastic deformation of the apparatus, a predetermined portion of the apparatus has a lower yield point than another portion of the apparatus. In an exemplary embodiment, the carbon content of the predetermined portion of the apparatus is less than or equal to 0.12 percent; and wherein the carbon equivalent value for the predetermined portion of the apparatus is less than 0.21. In an exemplary embodiment, the carbon content of the predetermined portion of the apparatus is greater than 0.12 percent; and wherein the carbon equivalent value for the predetermined portion of the apparatus is less than 0.36. In an exemplary embodiment, the apparatus further includes means for maintaining portions of the first and second tubular member in circumferential compression following the radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the apparatus further includes means for concentrating stresses within the mechanical connection during the radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the apparatus further includes means for

maintaining portions of the first and second tubular member in circumferential compression following the radial expansion and plastic deformation of the first and second tubular members; and means for concentrating stresses within the mechanical connection during the radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the apparatus further includes one or more stress concentrators for concentrating stresses in the joint. In an exemplary embodiment, one or more of the stress concentrators comprises one or more external grooves defined in the first tubular member. In an exemplary embodiment, one or more of the stress concentrators comprises one or more internal grooves defined in the second tubular member. In an exemplary embodiment, one or more of the stress concentrators comprises one or more openings defined in the sleeve. In an exemplary embodiment, one or more of the stress concentrators comprises one or more external grooves defined in the first tubular member; and wherein one or more of the stress concentrators comprises one or more internal grooves defined in the second tubular member. In an exemplary embodiment, one or more of the stress concentrators comprises one or more external grooves defined in the first tubular member; and wherein one or more of the stress concentrators comprises one or more openings defined in the sleeve. In an exemplary embodiment, one or more of the stress concentrators comprises one or more internal grooves defined in the second tubular member; and wherein one or more of the stress concentrators comprises one or more openings defined in the sleeve. In an exemplary embodiment, one or more of the stress concentrators comprises one or more external grooves defined in the first tubular member; wherein one or more of the stress concentrators comprises one or more internal grooves defined in the second tubular member; and wherein one or more of the stress concentrators comprises one or more openings defined in the sleeve. In an exemplary embodiment, the first tubular member further comprises an annular extension extending therefrom; and wherein the flange of the sleeve defines an annular recess for receiving and mating with the annular extension of the first tubular member. In an exemplary embodiment, the apparatus further includes a threaded connection for coupling a portion of the first and second tubular members; wherein at least a portion of the threaded connection is upset. In an exemplary embodiment, at least a portion of tubular sleeve penetrates the first tubular member. In an exemplary embodiment, the apparatus further includes means for increasing the axial compression loading capacity of the joint between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the apparatus further includes means for increasing the axial tension loading capacity of the joint between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the apparatus further includes means for

increasing the axial compression and tension loading capacity of the joint between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the apparatus further includes means for avoiding stress risers in the joint between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the apparatus further includes means for inducing stresses at selected portions of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the sleeve is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed. In an exemplary embodiment, the means for increasing the axial compression loading capacity of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed. In an exemplary embodiment, the means for increasing the axial tension loading capacity of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed. In an exemplary embodiment, the means for increasing the axial compression and tension loading capacity of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed. In an exemplary embodiment, the means for avoiding stress risers in the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed. In an exemplary embodiment, the means for inducing stresses at selected portions of the coupling between the first and second tubular members before and after a radial expansion and plastic deformation of the first and second tubular members is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed. In an exemplary embodiment, at least a portion of the sleeve is comprised of a frangible material. In an exemplary embodiment, the wall thickness of the sleeve is variable. In an exemplary embodiment, the predetermined portion of the apparatus has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the apparatus has a higher ductility prior to the radial expansion and plastic deformation than after the radial expansion and

plastic deformation. In an exemplary embodiment, the predetermined portion of the apparatus has a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the apparatus has a larger inside diameter after the radial expansion and plastic deformation than other portions of the tubular assembly. In an exemplary embodiment, the sleeve is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed. In an exemplary embodiment, the sleeve is circumferentially tensioned; and wherein the first and second tubular members are circumferentially compressed. In an exemplary embodiment, the apparatus further includes positioning another apparatus within the preexisting structure in overlapping relation to the apparatus; and radially expanding and plastically deforming the other apparatus within the preexisting structure; wherein, prior to the radial expansion and plastic deformation of the apparatus, a predetermined portion of the other apparatus has a lower yield point than another portion of the other apparatus. In an exemplary embodiment, the inside diameter of the radially expanded and plastically deformed other portion of the apparatus is equal to the inside diameter of the radially expanded and plastically deformed other portion of the other apparatus. In an exemplary embodiment, the predetermined portion of the apparatus comprises an end portion of the apparatus. In an exemplary embodiment, the predetermined portion of the apparatus comprises a plurality of predetermined portions of the apparatus. In an exemplary embodiment, the predetermined portion of the apparatus comprises a plurality of spaced apart predetermined portions of the apparatus. In an exemplary embodiment, the other portion of the apparatus comprises an end portion of the apparatus. In an exemplary embodiment, the other portion of the apparatus comprises a plurality of other portions of the apparatus. In an exemplary embodiment, the other portion of the apparatus comprises a plurality of spaced apart other portions of the apparatus. In an exemplary embodiment, the apparatus comprises a plurality of tubular members coupled to one another by corresponding tubular couplings. In an exemplary embodiment, the tubular couplings comprise the predetermined portions of the apparatus; and wherein the tubular members comprise the other portion of the apparatus. In an exemplary embodiment, one or more of the tubular couplings comprise the predetermined portions of the apparatus. In an exemplary embodiment, one or more of the tubular members comprise the predetermined portions of the apparatus. In an exemplary embodiment, the predetermined portion of the apparatus defines one or more openings. In an exemplary embodiment, one or more of the openings comprise slots. In an exemplary embodiment, the anisotropy for the predetermined portion of the apparatus is greater than 1. In an exemplary embodiment, the anisotropy for the predetermined portion of the apparatus is greater than 1. In an exemplary embodiment, the strain hardening exponent for the predetermined portion of the apparatus is

greater than 0.12. In an exemplary embodiment, the anisotropy for the predetermined portion of the apparatus is greater than 1; and wherein the strain hardening exponent for the predetermined portion of the apparatus is greater than 0.12. In an exemplary embodiment, the predetermined portion of the apparatus comprises a first steel alloy comprising: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the apparatus is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the apparatus prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is about 1.48. In an exemplary embodiment, the predetermined portion of the apparatus comprises a second steel alloy comprising: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the apparatus is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the apparatus prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is about 1.04. In an exemplary embodiment, the predetermined portion of the apparatus comprises a third steel alloy comprising: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is about 1.92. In an exemplary embodiment, the predetermined portion of the apparatus comprises a fourth steel alloy comprising: 0.02 % C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is about 1.34. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the apparatus is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of

the apparatus after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the apparatus prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is at least about 1.48. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the apparatus is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the apparatus prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is at least about 1.04. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is at least about 1.92. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is at least about 1.34. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, ranges from about 1.04 to about 1.92. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is greater than 0.12. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the apparatus is greater than the expandability coefficient of the other portion of the apparatus. In an exemplary embodiment, the apparatus comprises a wellbore casing. In an exemplary embodiment, the apparatus comprises a pipeline. In an exemplary embodiment, the apparatus comprises a structural support.

[00573] A radially expandable tubular member apparatus has been described that includes a first tubular member; a second tubular member engaged with the first tubular member forming a joint; a sleeve overlapping and coupling the first and second tubular members at the joint; the sleeve having opposite tapered ends and a flange engaged in a recess formed in an adjacent tubular member; and one of the tapered ends being a surface formed on the flange; wherein, prior to a radial expansion and plastic deformation of the apparatus, a predetermined portion of the apparatus has a lower yield point than another portion of the apparatus. In an exemplary embodiment, the recess includes a tapered wall in mating engagement with the tapered end formed on the flange. In an exemplary

embodiment, the sleeve includes a flange at each tapered end and each tapered end is formed on a respective flange. In an exemplary embodiment, each tubular member includes a recess. In an exemplary embodiment, each flange is engaged in a respective one of the recesses. In an exemplary embodiment, each recess includes a tapered wall in mating engagement with the tapered end formed on a respective one of the flanges. In an exemplary embodiment, the predetermined portion of the apparatus has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the apparatus has a higher ductility prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the apparatus has a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the apparatus has a larger inside diameter after the radial expansion and plastic deformation than other portions of the tubular assembly. In an exemplary embodiment, the apparatus further includes positioning another apparatus within the preexisting structure in overlapping relation to the apparatus; and radially expanding and plastically deforming the other apparatus within the preexisting structure; wherein, prior to the radial expansion and plastic deformation of the apparatus, a predetermined portion of the other apparatus has a lower yield point than another portion of the other apparatus. In an exemplary embodiment, the inside diameter of the radially expanded and plastically deformed other portion of the apparatus is equal to the inside diameter of the radially expanded and plastically deformed other portion of the other apparatus. In an exemplary embodiment, the predetermined portion of the apparatus comprises an end portion of the apparatus. In an exemplary embodiment, the predetermined portion of the apparatus comprises a plurality of predetermined portions of the apparatus. In an exemplary embodiment, the predetermined portion of the apparatus comprises a plurality of spaced apart predetermined portions of the apparatus. In an exemplary embodiment, the other portion of the apparatus comprises an end portion of the apparatus. In an exemplary embodiment, the other portion of the apparatus comprises a plurality of other portions of the apparatus. In an exemplary embodiment, the other portion of the apparatus comprises a plurality of spaced apart other portions of the apparatus. In an exemplary embodiment, the apparatus comprises a plurality of tubular members coupled to one another by corresponding tubular couplings. In an exemplary embodiment, the tubular couplings comprise the predetermined portions of the apparatus; and wherein the tubular members comprise the other portion of the apparatus. In an exemplary embodiment, one or more of the tubular couplings comprise the predetermined portions of the apparatus. In an exemplary embodiment, one or more of the tubular members comprise the predetermined

portions of the apparatus. In an exemplary embodiment, the predetermined portion of the apparatus defines one or more openings. In an exemplary embodiment, one or more of the openings comprise slots. In an exemplary embodiment, the anisotropy for the predetermined portion of the apparatus is greater than 1. In an exemplary embodiment, the anisotropy for the predetermined portion of the apparatus is greater than 1. In an exemplary embodiment, the strain hardening exponent for the predetermined portion of the apparatus is greater than 0.12. In an exemplary embodiment, the anisotropy for the predetermined portion of the apparatus is greater than 1; and wherein the strain hardening exponent for the predetermined portion of the apparatus is greater than 0.12. In an exemplary embodiment, the predetermined portion of the apparatus comprises a first steel alloy comprising: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the apparatus is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the apparatus prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is about 1.48. In an exemplary embodiment, the predetermined portion of the apparatus comprises a second steel alloy comprising: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the apparatus is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the apparatus prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is about 1.04. In an exemplary embodiment, the predetermined portion of the apparatus comprises a third steel alloy comprising: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is about 1.92. In an exemplary embodiment, the predetermined portion of the apparatus comprises a fourth steel alloy comprising: 0.02 % C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary

embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is about 1.34. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the apparatus is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the apparatus prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is at least about 1.48. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the apparatus is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the apparatus prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is at least about 1.04. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is at least about 1.92. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is at least about 1.34. In an exemplary embodiment, the anisotropy of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, ranges from about 1.04 to about 1.92. In an exemplary embodiment, the yield point of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the apparatus, prior to the radial expansion and plastic deformation, is greater than 0.12. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the apparatus is greater than the expandability coefficient of the other portion of the apparatus. In an exemplary embodiment, the apparatus comprises a wellbore casing. In an exemplary embodiment, the apparatus comprises a pipeline. In an exemplary embodiment, the apparatus comprises a structural support.

[00574] A method of joining radially expandable tubular members has been provided that includes: providing a first tubular member; engaging a second tubular member with the first tubular member to form a joint; providing a sleeve; mounting the sleeve for overlapping

and coupling the first and second tubular members at the joint; wherein the first tubular member, the second tubular member, and the sleeve define a tubular assembly; and radially expanding and plastically deforming the tubular assembly; wherein, prior to the radial expansion and plastic deformation, a predetermined portion of the tubular assembly has a lower yield point than another portion of the tubular assembly. In an exemplary embodiment, the carbon content of the predetermined portion of the tubular assembly is less than or equal to 0.12 percent; and wherein the carbon equivalent value for the predetermined portion of the tubular assembly is less than 0.21. In an exemplary embodiment, the carbon content of the predetermined portion of the tubular assembly is greater than 0.12 percent; and wherein the carbon equivalent value for the predetermined portion of the tubular assembly is less than 0.36. In an exemplary embodiment, the method further includes: maintaining portions of the first and second tubular member in circumferential compression following a radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the method further includes: concentrating stresses within the joint during a radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the method further includes: maintaining portions of the first and second tubular member in circumferential compression following a radial expansion and plastic deformation of the first and second tubular members; and concentrating stresses within the joint during a radial expansion and plastic deformation of the first and second tubular members. In an exemplary embodiment, the method further includes: concentrating stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the first tubular member to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the second tubular member to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the sleeve to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the first tubular member and the second tubular member to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the first tubular member and the sleeve to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the second tubular member and the sleeve to concentrate stresses within the joint. In an exemplary embodiment, concentrating stresses within the joint comprises using the first tubular member, the second tubular member, and the sleeve to concentrate stresses within the joint. In an exemplary embodiment, at least a portion of the sleeve is comprised of a frangible material. In an exemplary embodiment, the sleeve comprises a variable wall thickness. In an exemplary embodiment, the method further includes maintaining the sleeve in circumferential tension; and maintaining the first and second tubular members in

circumferential compression. In an exemplary embodiment, the method further includes maintaining the sleeve in circumferential tension; and maintaining the first and second tubular members in circumferential compression. In an exemplary embodiment, the method further includes: maintaining the sleeve in circumferential tension; and maintaining the first and second tubular members in circumferential compression. In an exemplary embodiment, the method further includes: threadably coupling the first and second tubular members at a first location; threadably coupling the first and second tubular members at a second location spaced apart from the first location; providing a plurality of sleeves; and mounting the sleeves at spaced apart locations for overlapping and coupling the first and second tubular members. In an exemplary embodiment, at least one of the tubular sleeves is positioned in opposing relation to the first threaded coupling; and wherein at least one of the tubular sleeves is positioned in opposing relation to the second threaded coupling. In an exemplary embodiment, at least one of the tubular sleeves is not positioned in opposing relation to the first and second threaded couplings. In an exemplary embodiment, the method further includes: threadably coupling the first and second tubular members; and upsetting the threaded coupling. In an exemplary embodiment, the first tubular member further comprises an annular extension extending therefrom; and wherein the flange of the sleeve defines an annular recess for receiving and mating with the annular extension of the first tubular member. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a larger inside diameter after the radial expansion and plastic deformation than the other portion of the tubular assembly. In an exemplary embodiment, the method further includes: positioning another tubular assembly within the preexisting structure in overlapping relation to the tubular assembly; and radially expanding and plastically deforming the other tubular assembly within the preexisting structure; wherein, prior to the radial expansion and plastic deformation of the tubular assembly, a predetermined portion of the other tubular assembly has a lower yield point than another portion of the other tubular assembly. In an exemplary embodiment, the inside diameter of the radially expanded and plastically deformed other portion of the tubular assembly is equal to the inside diameter of the radially expanded and plastically deformed other portion of the other tubular assembly. In an exemplary embodiment, the

predetermined portion of the tubular assembly comprises an end portion of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a plurality of predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a plurality of spaced apart predetermined portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises an end portion of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises a plurality of other portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises a plurality of spaced apart other portions of the tubular assembly. In an exemplary embodiment, the tubular assembly comprises a plurality of tubular members coupled to one another by corresponding tubular couplings. In an exemplary embodiment, the tubular couplings comprise the predetermined portions of the tubular assembly; and wherein the tubular members comprise the other portion of the tubular assembly. In an exemplary embodiment, one or more of the tubular couplings comprise the predetermined portions of the tubular assembly. In an exemplary embodiment, one or more of the tubular members comprise the predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly defines one or more openings. In an exemplary embodiment, one or more of the openings comprise slots. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary embodiment, the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1; and wherein the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a first steel alloy comprising: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.48. In an exemplary embodiment, the predetermined portion

of the tubular assembly comprises a second steel alloy comprising: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.04. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a third steel alloy comprising: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.92. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a fourth steel alloy comprising: 0.02 % C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.34. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.48. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at

least about 1.04. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.92. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.34. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, ranges from about 1.04 to about 1.92. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is greater than 0.12. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly is greater than the expandability coefficient of the other portion of the tubular assembly. In an exemplary embodiment, the tubular assembly comprises a wellbore casing. In an exemplary embodiment, the tubular assembly comprises a pipeline. In an exemplary embodiment, the tubular assembly comprises a structural support.

[00575] A method of joining radially expandable tubular members has been described that includes: providing a first tubular member; engaging a second tubular member with the first tubular member to form a joint; providing a sleeve having opposite tapered ends and a flange, one of the tapered ends being a surface formed on the flange; mounting the sleeve for overlapping and coupling the first and second tubular members at the joint, wherein the flange is engaged in a recess formed in an adjacent one of the tubular members; wherein the first tubular member, the second tubular member, and the sleeve define a tubular assembly; and radially expanding and plastically deforming the tubular assembly; wherein, prior to the radial expansion and plastic deformation, a predetermined portion of the tubular assembly has a lower yield point than another portion of the tubular assembly. In an exemplary embodiment, the method further includes: providing a tapered wall in the recess for mating engagement with the tapered end formed on the flange. In an exemplary embodiment, the method further includes: providing a flange at each tapered end wherein each tapered end is formed on a respective flange. In an exemplary embodiment, the method further includes: providing a recess in each tubular member. In an exemplary embodiment, the method further includes: engaging each flange in a respective one of the recesses. In an exemplary embodiment, the method further includes: providing a tapered wall in each recess for mating engagement with the tapered end formed on a respective one of the flanges. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary

embodiment, the predetermined portion of the tubular assembly has a higher ductility prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a larger inside diameter after the radial expansion and plastic deformation than the other portion of the tubular assembly. In an exemplary embodiment, the method further includes: positioning another tubular assembly within the preexisting structure in overlapping relation to the tubular assembly; and radially expanding and plastically deforming the other tubular assembly within the preexisting structure; wherein, prior to the radial expansion and plastic deformation of the tubular assembly, a predetermined portion of the other tubular assembly has a lower yield point than another portion of the other tubular assembly. In an exemplary embodiment, the inside diameter of the radially expanded and plastically deformed other portion of the tubular assembly is equal to the inside diameter of the radially expanded and plastically deformed other portion of the other tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises an end portion of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a plurality of predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a plurality of spaced apart predetermined portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises an end portion of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises a plurality of other portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises a plurality of spaced apart other portions of the tubular assembly. In an exemplary embodiment, the tubular assembly comprises a plurality of tubular members coupled to one another by corresponding tubular couplings. In an exemplary embodiment, the tubular couplings comprise the predetermined portions of the tubular assembly; and wherein the tubular members comprise the other portion of the tubular assembly. In an exemplary embodiment, one or more of the tubular couplings comprise the predetermined portions of the tubular assembly. In an exemplary embodiment, one or more of the tubular members comprise the predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly defines one or more openings. In an exemplary embodiment, one or more of the openings comprise slots. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary

embodiment, the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1; and wherein the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a first steel alloy comprising: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.48. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a second steel alloy comprising: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.04. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a third steel alloy comprising: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.92. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a fourth steel alloy comprising: 0.02 % C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.34. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi prior to the radial expansion and plastic

deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.48. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.04. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.92. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.34. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, ranges from about 1.04 to about 1.92. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is greater than 0.12. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly is greater than the expandability coefficient of the other portion of the tubular assembly. In an exemplary embodiment, the tubular assembly comprises a wellbore casing. In an exemplary embodiment, the tubular assembly comprises a pipeline. In an exemplary embodiment, the tubular assembly comprises a structural support.

[00576] An expandable tubular assembly has been described that includes a first tubular member; a second tubular member coupled to the first tubular member; a first threaded connection for coupling a portion of the first and second tubular members; a second threaded connection spaced apart from the first threaded connection for coupling another portion of the first and second tubular members; a tubular sleeve coupled to and

receiving end portions of the first and second tubular members; and a sealing element positioned between the first and second spaced apart threaded connections for sealing an interface between the first and second tubular member; wherein the sealing element is positioned within an annulus defined between the first and second tubular members; and wherein, prior to a radial expansion and plastic deformation of the assembly, a predetermined portion of the assembly has a lower yield point than another portion of the apparatus. In an exemplary embodiment, the predetermined portion of the assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the assembly has a higher ductility prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the assembly has a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the assembly has a larger inside diameter after the radial expansion and plastic deformation than other portions of the tubular assembly. In an exemplary embodiment, the assembly further includes: positioning another assembly within the preexisting structure in overlapping relation to the assembly; and radially expanding and plastically deforming the other assembly within the preexisting structure; wherein, prior to the radial expansion and plastic deformation of the assembly, a predetermined portion of the other assembly has a lower yield point than another portion of the other assembly. In an exemplary embodiment, the inside diameter of the radially expanded and plastically deformed other portion of the assembly is equal to the inside diameter of the radially expanded and plastically deformed other portion of the other assembly. In an exemplary embodiment, the predetermined portion of the assembly comprises an end portion of the assembly. In an exemplary embodiment, the predetermined portion of the assembly comprises a plurality of predetermined portions of the assembly. In an exemplary embodiment, the predetermined portion of the assembly comprises a plurality of spaced apart predetermined portions of the assembly. In an exemplary embodiment, the other portion of the assembly comprises an end portion of the assembly. In an exemplary embodiment, the other portion of the assembly comprises a plurality of other portions of the assembly. In an exemplary embodiment, the other portion of the assembly comprises a plurality of spaced apart other portions of the assembly. In an exemplary embodiment, the assembly comprises a plurality of tubular members coupled to one another by corresponding tubular couplings. In an exemplary embodiment, the tubular couplings comprise the predetermined portions of the assembly; and wherein the tubular members comprise the other portion of the assembly. In an exemplary embodiment, one or more of the tubular couplings comprise the predetermined portions of the assembly. In an exemplary

embodiment, one or more of the tubular members comprise the predetermined portions of the assembly. In an exemplary embodiment, the predetermined portion of the assembly defines one or more openings. In an exemplary embodiment, one or more of the openings comprise slots. In an exemplary embodiment, the anisotropy for the predetermined portion of the assembly is greater than 1. In an exemplary embodiment, the anisotropy for the predetermined portion of the assembly is greater than 1. In an exemplary embodiment, the strain hardening exponent for the predetermined portion of the assembly is greater than 0.12. In an exemplary embodiment, the anisotropy for the predetermined portion of the assembly is greater than 1; and wherein the strain hardening exponent for the predetermined portion of the assembly is greater than 0.12. In an exemplary embodiment, the predetermined portion of the assembly comprises a first steel alloy comprising: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is about 1.48. In an exemplary embodiment, the predetermined portion of the assembly comprises a second steel alloy comprising: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is about 1.04. In an exemplary embodiment, the predetermined portion of the assembly comprises a third steel alloy comprising: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is about 1.92. In an exemplary embodiment, the predetermined portion of the assembly comprises a fourth steel alloy comprising: 0.02 %

C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is about 1.34. In an exemplary embodiment, the yield point of the predetermined portion of the assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is at least about 1.48. In an exemplary embodiment, the yield point of the predetermined portion of the assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is at least about 1.04. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is at least about 1.92. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is at least about 1.34. In an exemplary embodiment, the anisotropy of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, ranges from about 1.04 to about 1.92. In an exemplary embodiment, the yield point of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the assembly, prior to the radial expansion and plastic deformation, is greater than 0.12. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the assembly is greater than the expandability coefficient of the other portion of the assembly. In an exemplary embodiment, the assembly comprises a wellbore casing. In an exemplary embodiment, the assembly comprises a pipeline. In an exemplary embodiment, the assembly comprises a structural support. In an exemplary embodiment, the annulus is at least partially defined by an irregular surface. In an exemplary embodiment, the annulus is at least partially defined by a toothed surface. In an exemplary embodiment, the sealing element comprises an

elastomeric material. In an exemplary embodiment, the sealing element comprises a metallic material. In an exemplary embodiment, the sealing element comprises an elastomeric and a metallic material.

[00577] A method of joining radially expandable tubular members is provided that includes providing a first tubular member; providing a second tubular member; providing a sleeve; mounting the sleeve for overlapping and coupling the first and second tubular members; threadably coupling the first and second tubular members at a first location; threadably coupling the first and second tubular members at a second location spaced apart from the first location; sealing an interface between the first and second tubular members between the first and second locations using a compressible sealing element, wherein the first tubular member, second tubular member, sleeve, and the sealing element define a tubular assembly; and radially expanding and plastically deforming the tubular assembly; wherein, prior to the radial expansion and plastic deformation, a predetermined portion of the tubular assembly has a lower yield point than another portion of the tubular assembly. In an exemplary embodiment, the sealing element includes an irregular surface. In an exemplary embodiment, the sealing element includes a toothed surface. In an exemplary embodiment, the sealing element comprises an elastomeric material. In an exemplary embodiment, the sealing element comprises a metallic material. In an exemplary embodiment, the sealing element comprises an elastomeric and a metallic material. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a higher ductility prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the predetermined portion of the tubular assembly has a larger inside diameter after the radial expansion and plastic deformation than the other portion of the tubular assembly. In an exemplary embodiment, the method further includes: positioning another tubular assembly within the preexisting structure in overlapping relation to the tubular assembly; and radially expanding and plastically deforming the other tubular assembly within the preexisting structure; wherein, prior to the radial expansion and plastic deformation of the tubular assembly, a predetermined portion of the other tubular assembly has a lower yield point than another portion of the other tubular assembly. In an exemplary embodiment, the inside diameter of the radially expanded and plastically deformed other portion of the tubular assembly is equal to the inside diameter of the radially expanded and plastically deformed other portion of the other tubular assembly. In an exemplary

embodiment, the predetermined portion of the tubular assembly comprises an end portion of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a plurality of predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a plurality of spaced apart predetermined portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises an end portion of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises a plurality of other portions of the tubular assembly. In an exemplary embodiment, the other portion of the tubular assembly comprises a plurality of spaced apart other portions of the tubular assembly. In an exemplary embodiment, the tubular assembly comprises a plurality of tubular members coupled to one another by corresponding tubular couplings. In an exemplary embodiment, the tubular couplings comprise the predetermined portions of the tubular assembly; and wherein the tubular members comprise the other portion of the tubular assembly. In an exemplary embodiment, one or more of the tubular couplings comprise the predetermined portions of the tubular assembly. In an exemplary embodiment, one or more of the tubular members comprise the predetermined portions of the tubular assembly. In an exemplary embodiment, the predetermined portion of the tubular assembly defines one or more openings. In an exemplary embodiment, one or more of the openings comprise slots. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1. In an exemplary embodiment, the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the anisotropy for the predetermined portion of the tubular assembly is greater than 1; and wherein the strain hardening exponent for the predetermined portion of the tubular assembly is greater than 0.12. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a first steel alloy comprising: 0.065 % C, 1.44 % Mn, 0.01 % P, 0.002 % S, 0.24 % Si, 0.01 % Cu, 0.01 % Ni, and 0.02 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.48. In an exemplary

embodiment, the predetermined portion of the tubular assembly comprises a second steel alloy comprising: 0.18 % C, 1.28 % Mn, 0.017 % P, 0.004 % S, 0.29 % Si, 0.01 % Cu, 0.01 % Ni, and 0.03 % Cr. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.04. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a third steel alloy comprising: 0.08 % C, 0.82 % Mn, 0.006 % P, 0.003 % S, 0.30 % Si, 0.16 % Cu, 0.05 % Ni, and 0.05 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.92. In an exemplary embodiment, the predetermined portion of the tubular assembly comprises a fourth steel alloy comprising: 0.02 % C, 1.31 % Mn, 0.02 % P, 0.001 % S, 0.45 % Si, 9.1 % Ni, and 18.7 % Cr. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is about 1.34. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 46.9 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 65.9 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 40 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.48. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly is at most about 57.8 ksi prior to the radial expansion and plastic deformation; and wherein the yield point of the predetermined portion of the tubular assembly is at least about 74.4 ksi after the radial expansion and plastic deformation. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly after the radial expansion and plastic deformation is at least about 28 % greater than the yield point of the predetermined portion of the tubular assembly prior to the radial expansion and plastic deformation. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly,

prior to the radial expansion and plastic deformation, is at least about 1.04. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.92. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is at least about 1.34. In an exemplary embodiment, the anisotropy of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, ranges from about 1.04 to about 1.92. In an exemplary embodiment, the yield point of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, ranges from about 47.6 ksi to about 61.7 ksi. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly, prior to the radial expansion and plastic deformation, is greater than 0.12. In an exemplary embodiment, the expandability coefficient of the predetermined portion of the tubular assembly is greater than the expandability coefficient of the other portion of the tubular assembly. In an exemplary embodiment, the tubular assembly comprises a wellbore casing. In an exemplary embodiment, the tubular assembly comprises a pipeline. In an exemplary embodiment, the tubular assembly comprises a structural support. In an exemplary embodiment, the sleeve comprises: a plurality of spaced apart tubular sleeves coupled to and receiving end portions of the first and second tubular members. In an exemplary embodiment, the first tubular member comprises a first threaded connection; wherein the second tubular member comprises a second threaded connection; wherein the first and second threaded connections are coupled to one another; wherein at least one of the tubular sleeves is positioned in opposing relation to the first threaded connection; and wherein at least one of the tubular sleeves is positioned in opposing relation to the second threaded connection. In an exemplary embodiment, the first tubular member comprises a first threaded connection; wherein the second tubular member comprises a second threaded connection; wherein the first and second threaded connections are coupled to one another; and wherein at least one of the tubular sleeves is not positioned in opposing relation to the first and second threaded connections. In an exemplary embodiment, the carbon content of the tubular member is less than or equal to 0.12 percent; and wherein the carbon equivalent value for the tubular member is less than 0.21. In an exemplary embodiment, the tubular member comprises a wellbore casing.

[00578] An expandable tubular member has been described, wherein the carbon content of the tubular member is greater than 0.12 percent; and wherein the carbon equivalent value for the tubular member is less than 0.36. In an exemplary embodiment, the tubular member comprises a wellbore casing.

[00579] A method of selecting tubular members for radial expansion and plastic deformation has been described that includes: selecting a tubular member from a collection

of tubular member; determining a carbon content of the selected tubular member; determining a carbon equivalent value for the selected tubular member; and if the carbon content of the selected tubular member is less than or equal to 0.12 percent and the carbon equivalent value for the selected tubular member is less than 0.21, then determining that the selected tubular member is suitable for radial expansion and plastic deformation.

[00580] A method of selecting tubular members for radial expansion and plastic deformation has been described that includes: selecting a tubular member from a collection of tubular member; determining a carbon content of the selected tubular member; determining a carbon equivalent value for the selected tubular member; and if the carbon content of the selected tubular member is greater than 0.12 percent and the carbon equivalent value for the selected tubular member is less than 0.36, then determining that the selected tubular member is suitable for radial expansion and plastic deformation.

[00581] An expandable tubular member has been described that includes: a tubular body; wherein a yield point of an inner tubular portion of the tubular body is less than a yield point of an outer tubular portion of the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in an linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in an non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies in an linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the outer tubular portion of the tubular body varies in an non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield

point of the inner tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the yield point of the inner tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body; and wherein the yield point of the outer tubular portion of the tubular body varies in a non-linear fashion as a function of the radial position within the tubular body. In an exemplary embodiment, the rate of change of the yield point of the inner tubular portion of the tubular body is different than the rate of change of the yield point of the outer tubular portion of the tubular body. In an exemplary embodiment, the rate of change of the yield point of the inner tubular portion of the tubular body is different than the rate of change of the yield point of the outer tubular portion of the tubular body.

[00582] A method of manufacturing an expandable tubular member has been described that includes: providing a tubular member; heat treating the tubular member; and quenching the tubular member; wherein following the quenching, the tubular member comprises a microstructure comprising a hard phase structure and a soft phase structure. In an exemplary embodiment, the provided tubular member comprises, by weight percentage, 0.065% C, 1.44% Mn, 0.01% P, 0.002% S, 0.24% Si, 0.01% Cu, 0.01% Ni, 0.02% Cr, 0.05% V, 0.01% Mo, 0.01% Nb, and 0.01%Ti. In an exemplary embodiment, the provided tubular member comprises, by weight percentage, 0.18% C, 1.28% Mn, 0.017% P, 0.004% S, 0.29% Si, 0.01% Cu, 0.01% Ni, 0.03% Cr, 0.04% V, 0.01% Mo, 0.03% Nb, and 0.01%Ti. In an exemplary embodiment, the provided tubular member comprises, by weight percentage, 0.08% C, 0.82% Mn, 0.006% P, 0.003% S, 0.30% Si, 0.06% Cu, 0.05% Ni, 0.05% Cr, 0.03% V, 0.03% Mo, 0.01% Nb, and 0.01%Ti. In an exemplary embodiment, the provided tubular member comprises a microstructure comprising one or more of the following: martensite, pearlite, vanadium carbide, nickel carbide, or titanium carbide. In an exemplary embodiment, the provided tubular member comprises a microstructure comprising one or more of the following: pearlite or pearlite striation. In an exemplary embodiment, the provided tubular member comprises a microstructure comprising one or more of the following: grain pearlite, widmanstatten martensite, vanadium carbide, nickel carbide, or titanium carbide. In an exemplary embodiment, the heat treating comprises heating the provided tubular member for about 10 minutes at 790 °C. In an exemplary embodiment, the quenching comprises quenching the heat treated tubular member in water. In an exemplary embodiment, following the quenching, the tubular member comprises a microstructure comprising one or more of the following: ferrite, grain pearlite, or martensite. In an exemplary embodiment, following the quenching, the tubular member comprises a microstructure comprising one or more of the following: ferrite, martensite, or bainite. In an

exemplary embodiment, following the quenching, the tubular member comprises a microstructure comprising one or more of the following: bainite, pearlite, or ferrite. In an exemplary embodiment, following the quenching, the tubular member comprises a yield strength of about 67ksi and a tensile strength of about 95 ksi. In an exemplary embodiment, following the quenching, the tubular member comprises a yield strength of about 82 ksi and a tensile strength of about 130 ksi. In an exemplary embodiment, following the quenching, the tubular member comprises a yield strength of about 60 ksi and a tensile strength of about 97 ksi. In an exemplary embodiment, the method further includes: positioning the quenched tubular member within a preexisting structure; and radially expanding and plastically deforming the tubular member within the preexisting structure.

[00583] A method of radially expanding a tubular assembly has been described that includes radially expanding and plastically deforming a lower portion of the tubular assembly by pressurizing the interior of the lower portion of the tubular assembly; and then, radially expanding and plastically deforming the remaining portion of the tubular assembly by contacting the interior of the tubular assembly with an expansion device. In an exemplary embodiment, the expansion device is an adjustable expansion device. In an exemplary embodiment, the expansion device is a hydroforming expansion device. In an exemplary embodiment, the expansion device is a rotary expansion device. In an exemplary embodiment, the lower portion of the tubular assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the remaining portion of the tubular assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the lower portion of the tubular assembly includes a shoe defining a valveable passage.

[00584] A system for radially expanding a tubular assembly has been described that includes means for radially expanding and plastically deforming a lower portion of the tubular assembly by pressurizing the interior of the lower portion of the tubular assembly; and then, means for radially expanding and plastically deforming the remaining portion of the tubular assembly by contacting the interior of the tubular assembly with an expansion device. In an exemplary embodiment, the lower portion of the tubular assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the remaining portion of the tubular assembly has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation.

[00585] A method of repairing a tubular assembly has been described that includes positioning a tubular patch within the tubular assembly; and radially expanding and

plastically deforming a tubular patch into engagement with the tubular assembly by pressurizing the interior of the tubular patch. In an exemplary embodiment, the tubular patch has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation.

[00586] A system for repairing a tubular assembly has been described that includes means for positioning a tubular patch within the tubular assembly; and means for radially expanding and plastically deforming a tubular patch into engagement with the tubular assembly by pressurizing the interior of the tubular patch. In an exemplary embodiment, the tubular patch has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation.

[00587] A method of radially expanding a tubular member has been described that includes accumulating a supply of pressurized fluid; and controllably injecting the pressurized fluid into the interior of the tubular member. In an exemplary embodiment, accumulating the supply of pressurized fluid includes: monitoring the operating pressure of the accumulated fluid; and if the operating pressure of the accumulated fluid is less than a predetermined amount, injecting pressurized fluid into the accumulated fluid. In an exemplary embodiment, controllably injecting the pressurized fluid into the interior of the tubular member includes: monitoring the operating condition of the tubular member; and if the tubular member has been radial expanded, releasing the pressurized fluid from the interior of the tubular member.

[00588] A system for radially expanding a tubular member has been described that includes means for accumulating a supply of pressurized fluid; and means for controllably injecting the pressurized fluid into the interior of the tubular member. In an exemplary embodiment, means for accumulating the supply of pressurized fluid includes: means for monitoring the operating pressure of the accumulated fluid; and if the operating pressure of the accumulated fluid is less than a predetermined amount, means for injecting pressurized fluid into the accumulated fluid. In an exemplary embodiment, means for controllably injecting the pressurized fluid into the interior of the tubular member includes: means for monitoring the operating condition of the tubular member; and if the tubular member has been radial expanded, means for releasing the pressurized fluid from the interior of the tubular member.

[00589] An apparatus for radially expanding a tubular member has been described that includes a fluid reservoir; a pump for pumping fluids out of the fluid reservoir; an accumulator for receiving and accumulating the fluids pumped from the reservoir; a flow control valve for controllably releasing the fluids accumulated within the reservoir; and an expansion element for engaging the interior of the tubular member to define a pressure

chamber within the tubular member and receiving the released accumulated fluids into the pressure chamber.

[00590] An apparatus for radially expanding a tubular member has been described that includes an expandable tubular member; a locking device positioned within the expandable tubular member releasably coupled to the expandable tubular member; a tubular support member positioned within the expandable tubular member coupled to the locking device; and an adjustable expansion device positioned within the expandable tubular member coupled to the tubular support member; wherein at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the apparatus further includes: means for transmitting torque between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes: means for sealing the interface between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes: another tubular support member received within the tubular support member releasably coupled to the expandable tubular member. In an exemplary embodiment, the apparatus further includes: means for transmitting torque between the expandable tubular member and the other tubular support member. In an exemplary embodiment, the apparatus further includes: means for transmitting torque between the other tubular support member and the tubular support member. In an exemplary embodiment, the apparatus further includes: means for sealing the interface between the other tubular support member and the tubular support member. In an exemplary embodiment, the apparatus further includes: means for sealing the interface between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes: means for sensing the operating pressure within the other tubular support member. In an exemplary embodiment, the apparatus further includes: means for pressurizing the interior of the other tubular support member. In an exemplary embodiment, further includes: means for limiting axial displacement of the other tubular support member relative to the tubular support member. In an exemplary embodiment, the apparatus further includes: a tubular liner coupled to an end of the expandable tubular member. In an exemplary embodiment, the apparatus further includes: a tubular liner coupled to an end of the expandable tubular member.

[00591] An apparatus for radially expanding a tubular member has been described that includes: an expandable tubular member; a locking device positioned within the expandable tubular member releasably coupled to the expandable tubular member; a tubular support member positioned within the expandable tubular member coupled to the locking device; an adjustable expansion device positioned within the expandable tubular member

coupled to the tubular support member; means for transmitting torque between the expandable tubular member and the tubular support member; means for sealing the interface between the expandable tubular member and the tubular support member; another tubular support member received within the tubular support member releasably coupled to the expandable tubular member; means for transmitting torque between the expandable tubular member and the other tubular support member; means for transmitting torque between the other tubular support member and the tubular support member; means for sealing the interface between the other tubular support member and the tubular support member; means for sealing the interface between the expandable tubular member and the tubular support member; means for sensing the operating pressure within the other tubular support member; means for pressurizing the interior of the other tubular support member; means for limiting axial displacement of the other tubular support member relative to the tubular support member; and a tubular liner coupled to an end of the expandable tubular member; wherein at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation.

[00592] A method for radially expanding a tubular member has been described that includes positioning a tubular member and an adjustable expansion device within a preexisting structure; radially expanding and plastically deforming at least a portion of the tubular member by pressurizing an interior portion of the tubular member; increasing the size of the adjustable expansion device; and radially expanding and plastically deforming another portion of the tubular member by displacing the adjustable expansion device relative to the tubular member. In an exemplary embodiment, the method further includes sensing an operating pressure within the tubular member. In an exemplary embodiment, wherein radially expanding and plastically deforming at least a portion of the tubular member by pressurizing an interior portion of the tubular member includes: injecting fluidic material into the tubular member; sensing the operating pressure of the injected fluidic material; and if the operating pressure of the injected fluidic material exceeds a predetermined value, permitting the fluidic material to enter a pressure chamber defined within the tubular member. In an exemplary embodiment, at least a portion of the tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the portion of the tubular member comprises the pressurized portion of the tubular member.

[00593] A system for radially expanding a tubular member has been described that includes means for positioning a tubular member and an adjustable expansion device within a preexisting structure; means for radially expanding and plastically deforming at least a portion of the tubular member by pressurizing an interior portion of the tubular member;

means for increasing the size of the adjustable expansion device; and means for radially expanding and plastically deforming another portion of the tubular member by displacing the adjustable expansion device relative to the tubular member. In an exemplary embodiment, the system further includes: sensing an operating pressure within the tubular member. In an exemplary embodiment, radially expanding and plastically deforming at least a portion of the tubular member by pressurizing an interior portion of the tubular member includes: injecting fluidic material into the tubular member; sensing the operating pressure of the injected fluidic material; and if the operating pressure of the injected fluidic material exceeds a predetermined value, permitting the fluidic material to enter a pressure chamber defined within the tubular member. In an exemplary embodiment, at least a portion of the tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the portion of the tubular member includes the pressurized portion of the tubular member.

[00594] A method of radially expanding and plastically deforming an expandable tubular member has been described that includes limiting the amount of radial expansion of the expandable tubular member. In an exemplary embodiment, limiting the amount of radial expansion of the expandable tubular member includes: coupling another tubular member to the expandable tubular member that limits the amount of the radial expansion of the expandable tubular member. In an exemplary embodiment, the other tubular member defines one or more slots. In an exemplary embodiment, the other tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation.

[00595] An apparatus for radially expanding a tubular member has been described that includes an expandable tubular member; an expansion device coupled to the expandable tubular member for radially expanding and plastically deforming the expandable tubular member; and an tubular expansion limiter coupled to the expandable tubular member for limiting the degree to which the expandable tubular member may be radially expanded and plastically deformed. In an exemplary embodiment, the tubular expansion limiter includes a tubular member that defines one or more slots. In an exemplary embodiment, the tubular expansion limiter comprises a tubular member that has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the apparatus further includes: a locking device positioned within the expandable tubular member releasably coupled to the expandable tubular member; a tubular support member positioned within the expandable tubular member coupled to the locking device and the expansion device. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher

ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the apparatus further includes: means for transmitting torque between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes: means for sealing the interface between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes means for sealing the interface between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes: means for sensing the operating pressure within the tubular support member. In an exemplary embodiment, the apparatus further includes: means for pressurizing the interior of the tubular support member.

[00596] An apparatus for radially expanding a tubular member has been described that includes: an expandable tubular member; an expansion device coupled to the expandable tubular member for radially expanding and plastically deforming the expandable tubular member; an tubular expansion limiter coupled to the expandable tubular member for limiting the degree to which the expandable tubular member may be radially expanded and plastically deformed; a locking device positioned within the expandable tubular member releasably coupled to the expandable tubular member; a tubular support member positioned within the expandable tubular member coupled to the locking device and the expansion device; means for transmitting torque between the expandable tubular member and the tubular support member; means for sealing the interface between the expandable tubular member and the tubular support member; means for sensing the operating pressure within the tubular support member; and means for pressurizing the interior of the tubular support member; wherein at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation.

[00597] A method for radially expanding a tubular member has been described that includes positioning a tubular member and an adjustable expansion device within a preexisting structure; radially expanding and plastically deforming at least a portion of the tubular member by pressurizing an interior portion of the tubular member; limiting the extent to which the portion of the tubular member is radially expanded and plastically deformed by pressurizing the interior of the tubular member; increasing the size of the adjustable expansion device; and radially expanding and plastically deforming another portion of the tubular member by displacing the adjustable expansion device relative to the tubular member. In an exemplary embodiment, the method further includes sensing an operating pressure within the tubular member. In an exemplary embodiment, radially expanding and plastically deforming at least a portion of the tubular member by pressurizing an interior

portion of the tubular member includes: injecting fluidic material into the tubular member; sensing the operating pressure of the injected fluidic material; and if the operating pressure of the injected fluidic material exceeds a predetermined value, permitting the fluidic material to enter a pressure chamber defined within the tubular member. In an exemplary embodiment, at least a portion of the tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, limiting the extent to which the portion of the tubular member is radially expanded and plastically deformed by pressurizing the interior of the tubular member includes: applying a force to the exterior of the tubular member. In an exemplary embodiment, applying a force to the exterior of the tubular member includes: applying a variable force to the exterior of the tubular member.

[00598] A system for radially expanding a tubular member has been described that includes means for positioning a tubular member and an adjustable expansion device within a preexisting structure; means for radially expanding and plastically deforming at least a portion of the tubular member by pressurizing an interior portion of the tubular member; means for limiting the extent to which the portion of the tubular member is radially expanded and plastically deformed by pressurizing the interior of the tubular member; means for increasing the size of the adjustable expansion device; and means for radially expanding and plastically deforming another portion of the tubular member by displacing the adjustable expansion device relative to the tubular member. In an exemplary embodiment, the method further includes: means for sensing an operating pressure within the tubular member. In an exemplary embodiment, means for radially expanding and plastically deforming at least a portion of the tubular member by pressurizing an interior portion of the tubular member includes: means for injecting fluidic material into the tubular member; means for sensing the operating pressure of the injected fluidic material; and if the operating pressure of the injected fluidic material exceeds a predetermined value, means for permitting the fluidic material to enter a pressure chamber defined within the tubular member. In an exemplary embodiment, at least a portion of the tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, means for limiting the extent to which the portion of the tubular member is radially expanded and plastically deformed by pressurizing the interior of the tubular member includes: means for applying a force to the exterior of the tubular member. In an exemplary embodiment, wherein means for applying a force to the exterior of the tubular member includes: means for applying a variable force to the exterior of the tubular member.

[00599] An apparatus for radially expanding an expandable tubular member has been described that includes an expandable tubular member; a locking device positioned within

the expandable tubular member releasably coupled to the expandable tubular member; an actuator positioned within the expandable tubular member coupled to the locking device; a tubular support member positioned within the expandable tubular member coupled to the actuator; a first expansion device coupled to the tubular support member; a second expansion device coupled to the tubular support member; and an expandable tubular sleeve coupled to the second expansion device. In an exemplary embodiment, the outside diameters of the first and second expansion devices are unequal. In an exemplary embodiment, the outside diameter of the first expansion device is greater than the outside diameter of the second expansion device. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the outside diameters of the first and second expansion devices are both less than or equal to the outside diameter of the expandable tubular member. In an exemplary embodiment, the outside diameter of the expandable tubular sleeve is less than or equal to the outside diameter of the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for transmitting torque between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes means for pressurizing the interior of the tubular support member. In an exemplary embodiment, the apparatus further includes means for limiting axial displacement of the expandable tubular sleeve. In an exemplary embodiment, the apparatus further includes means for limiting axial displacement of the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for transmitting torque from the tubular support member to the means for limiting axial displacement of the expandable tubular sleeve. In an exemplary embodiment, the apparatus further includes means for displacing the first expansion device relative to the expandable tubular member to radially expand and plastically deform the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for displacing the second expansion device relative to the expandable tubular sleeve to radially expand and plastically deform the expandable tubular sleeve. In an exemplary embodiment, the wall thickness of the expandable tubular sleeve is variable. In an exemplary embodiment, the expandable tubular sleeve includes means for sealing an interface between the expandable tubular sleeve and the interior surface of the expandable tubular member.

[00600] An apparatus for radially expanding an expandable tubular member has been described that includes: an expandable tubular member; a locking device positioned within

the expandable tubular member releasably coupled to the expandable tubular member; an actuator positioned within the expandable tubular member coupled to the locking device; a tubular support member positioned within the expandable tubular member coupled to the actuator; a first expansion device coupled to the tubular support member; a second expansion device coupled to the tubular support member; an expandable tubular sleeve coupled to the second expansion device; means for transmitting torque between the expandable tubular member and the tubular support member; means for pressurizing the interior of the tubular support member; means for limiting axial displacement of the expandable tubular sleeve; means for limiting axial displacement of the expandable tubular member; means for transmitting torque from the tubular support member to the means for limiting axial displacement of the expandable tubular sleeve; means for displacing the first expansion device relative to the expandable tubular member to radially expand and plastically deform the expandable tubular member; and means for displacing the second expansion device relative to the expandable tubular sleeve to radially expand and plastically deform the expandable tubular sleeve; wherein the outside diameter of the first expansion device is greater than the outside diameter of the second expansion device; wherein at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation; wherein at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation; wherein the outside diameters of the first and second expansion devices are both less than or equal to the outside diameter of the expandable tubular member; wherein the outside diameter of the expandable tubular sleeve is less than or equal to the outside diameter of the expandable tubular member; wherein the wall thickness of the expandable tubular sleeve is variable; and wherein the expandable tubular sleeve comprises means for sealing an interface between the expandable tubular sleeve and the interior surface of the expandable tubular member.

[00601] A method for radially expanding a tubular member has been described that includes positioning an expandable tubular member and an expandable tubular sleeve within a preexisting structure; radially expanding and plastically deforming at least a portion of the expandable tubular member onto the expandable tubular sleeve; and radially expanding and plastically deforming at least a portion of the expandable tubular sleeve. In an exemplary embodiment, the method further includes radially expanding and plastically deforming at least a portion of the expandable tubular member while simultaneously radially expanding and plastically deforming at least a portion of the expandable tubular sleeve. In an exemplary embodiment, the method further includes radially expanding and plastically deforming another portion of the expandable tubular member after radially expanding and

plastically deforming the portion of the expandable tubular sleeve. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the wall thickness of the expandable tubular sleeve is variable. In an exemplary embodiment, the method further includes sealing an interface between the exterior surface of the expandable tubular sleeve and the interior surface of the expandable tubular member.

[00602] A system for radially expanding a tubular member has been described that includes means for positioning an expandable tubular member and an expandable tubular sleeve within a preexisting structure; means for radially expanding and plastically deforming at least a portion of the expandable tubular member onto the expandable tubular sleeve; and means for radially expanding and plastically deforming at least a portion of the expandable tubular sleeve. In an exemplary embodiment, the system further includes means for radially expanding and plastically deforming at least a portion of the expandable tubular member while simultaneously radially expanding and plastically deforming at least a portion of the expandable tubular sleeve. In an exemplary embodiment, the system further includes means for radially expanding and plastically deforming another portion of the expandable tubular member after radially expanding and plastically deforming the portion of the expandable tubular sleeve. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the wall thickness of the expandable tubular sleeve is variable. In an exemplary embodiment, the system further includes sealing an interface between the exterior surface of the expandable tubular sleeve and the interior surface of the expandable tubular member.

[00603] An apparatus for radially expanding an expandable tubular member has been described that includes an expandable tubular member; a locking device positioned within the expandable tubular member releasably coupled to the expandable tubular member; an actuator positioned within the expandable tubular member coupled to the locking device; a tubular support member positioned within the expandable tubular member coupled to the actuator; an adjustable expansion device coupled to the tubular support member; a non-adjustable expansion device coupled to the tubular support member; and an expandable

tubular sleeve coupled to the non-adjustable expansion device. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the outside diameters of the adjustable and non-adjustable expansion devices are both less than or equal to the outside diameter of the expandable tubular member. In an exemplary embodiment, the outside diameter of the expandable tubular sleeve is less than or equal to the outside diameter of the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for transmitting torque between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes means for pressurizing the interior of the tubular support member. In an exemplary embodiment, the apparatus further includes means for limiting axial displacement of the expandable tubular sleeve. In an exemplary embodiment, the apparatus further includes means for limiting axial displacement of the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for transmitting torque from the tubular support member to the means for limiting axial displacement of the expandable tubular sleeve. In an exemplary embodiment, the apparatus further includes means for transmitting torque from the tubular support member to the means for limiting axial displacement of the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for displacing the adjustable expansion device relative to the expandable tubular member to radially expand and plastically deform the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for pulling the adjustable expansion device through the expandable tubular member to radially expand and plastically deform the expandable tubular member. In an exemplary embodiment, the apparatus further includes fluid powered means for pulling the adjustable expansion device through the expandable tubular member to radially expand and plastically deform the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for displacing the non-adjustable expansion device relative to the expandable tubular sleeve to radially expand and plastically deform the expandable tubular sleeve. In an exemplary embodiment, the apparatus further includes fluid powered means for pulling the non-adjustable expansion device through the expandable tubular sleeve to radially expand and plastically deform the expandable tubular sleeve. In an exemplary embodiment, the wall thickness of the expandable tubular sleeve is variable. In an exemplary embodiment, the expandable tubular

sleeve includes means for sealing an interface between the expandable tubular sleeve and the interior surface of the expandable tubular member.

[00604] An apparatus for radially expanding an expandable tubular member has been described that includes an expandable tubular member; a locking device positioned within the expandable tubular member releasably coupled to the expandable tubular member; an actuator positioned within the expandable tubular member coupled to the locking device; a tubular support member positioned within the expandable tubular member coupled to the actuator; an adjustable expansion device coupled to the tubular support member; a non-adjustable expansion device coupled to the tubular support member; an expandable tubular sleeve coupled to the non-adjustable expansion device; means for transmitting torque between the expandable tubular member and the tubular support member; means for pressurizing the interior of the tubular support member; means for limiting axial displacement of the expandable tubular sleeve; means for limiting axial displacement of the expandable tubular member; means for transmitting torque from the tubular support member to the means for limiting axial displacement of the expandable tubular sleeve; means for transmitting torque from the tubular support member to the means for limiting axial displacement of the expandable tubular member; fluid powered means for pulling the adjustable expansion device through the expandable tubular member to radially expand and plastically deform the expandable tubular member; and fluid powered means for pulling the non-adjustable expansion device through the expandable tubular sleeve to radially expand and plastically deform the expandable tubular sleeve; wherein at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation; wherein at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation; wherein the outside diameters of the adjustable and non-adjustable expansion devices are both less than or equal to the outside diameter of the expandable tubular member; wherein the outside diameter of the expandable tubular sleeve is less than or equal to the outside diameter of the expandable tubular member; wherein the wall thickness of the expandable tubular sleeve is variable; and wherein the expandable tubular sleeve comprises means for sealing an interface between the expandable tubular sleeve and the interior surface of the expandable tubular member.

[00605] A method for radially expanding a tubular member has been described that includes positioning an expandable tubular member, an expandable tubular sleeve, and an adjustable expansion device within a preexisting structure; increasing the size of the adjustable expansion device; radially expanding and plastically deforming at least a portion of the expandable tubular member onto the expandable tubular sleeve using the adjustable

expansion device; and radially expanding and plastically deforming at least a portion of the expandable tubular sleeve. In an exemplary embodiment, the method further includes radially expanding and plastically deforming at least a portion of the expandable tubular member while simultaneously radially expanding and plastically deforming at least a portion of the expandable tubular sleeve. In an exemplary embodiment, the method further includes radially expanding and plastically deforming another portion of the expandable tubular member after radially expanding and plastically deforming the portion of the expandable tubular sleeve. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the wall thickness of the expandable tubular sleeve is variable. In an exemplary embodiment, the method further includes sealing an interface between the exterior surface of the expandable tubular sleeve and the interior surface of the expandable tubular member. In an exemplary embodiment, the method further includes pulling the adjustable expansion device through the expandable tubular member. In an exemplary embodiment, the method further includes pulling the adjustable expansion device through the expandable tubular member using fluid pressure.

[00606] A system for radially expanding a tubular member has been described that includes means for positioning an expandable tubular member, an expandable tubular sleeve, and an adjustable expansion device within a preexisting structure; means for increasing the size of the adjustable expansion device; means for radially expanding and plastically deforming at least a portion of the expandable tubular member onto the expandable tubular sleeve using the adjustable expansion device; and means for radially expanding and plastically deforming at least a portion of the expandable tubular sleeve. In an exemplary embodiment, the system further includes means for radially expanding and plastically deforming at least a portion of the expandable tubular member while simultaneously radially expanding and plastically deforming at least a portion of the expandable tubular sleeve. In an exemplary embodiment, the system further includes means for radially expanding and plastically deforming another portion of the expandable tubular member after radially expanding and plastically deforming the portion of the expandable tubular sleeve. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation

than after the radial expansion and plastic deformation. In an exemplary embodiment, the wall thickness of the expandable tubular sleeve is variable. In an exemplary embodiment, the system further includes means for sealing an interface between the exterior surface of the expandable tubular sleeve and the interior surface of the expandable tubular member. In an exemplary embodiment, the system further includes means for pulling the adjustable expansion device through the expandable tubular member. In an exemplary embodiment, the system further includes means for pulling the adjustable expansion device through the expandable tubular member using fluid pressure.

[00607] An apparatus for radially expanding an expandable tubular member has been described that includes an expandable tubular member; a locking device positioned within the expandable tubular member releasably coupled to the expandable tubular member; an actuator positioned within the expandable tubular member coupled to the locking device; a tubular support member positioned within the expandable tubular member coupled to the actuator; and an adjustable expansion device positioned within the expandable tubular member coupled to the tubular support member. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the apparatus further includes an expandable tubular sleeve coupled to an end of the expandable tubular member that receives the adjustable expansion device. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the apparatus further includes means for transmitting torque between the expandable tubular member and the tubular support member. In an exemplary embodiment, the apparatus further includes means for pressurizing the interior of the tubular support member. In an exemplary embodiment, the actuator includes means for displacing the adjustable expansion device relative to the expandable tubular member to radially expand and plastically deform the expandable tubular member. In an exemplary embodiment, the actuator further includes means for pulling the adjustable expansion device through the expandable tubular member to radially expand and plastically deform the expandable tubular member. In an exemplary embodiment, the actuator further includes fluid powered means for pulling the adjustable expansion device through the expandable tubular member to radially expand and plastically deform the expandable tubular member. In an exemplary embodiment, the apparatus further includes means for adjusting the size of the adjustable expansion device.

[00608] An apparatus for radially expanding an expandable tubular member has been described that includes an expandable tubular member; a locking device positioned within

the expandable tubular member releasably coupled to the expandable tubular member; an actuator positioned within the expandable tubular member coupled to the locking device; a tubular support member positioned within the expandable tubular member coupled to the actuator; an adjustable expansion device positioned within the expandable tubular member coupled to the tubular support member; an expandable tubular sleeve coupled to an end of the expandable tubular member that receives the adjustable expansion device; means for transmitting torque between the expandable tubular member and the tubular support member; means for pressurizing the interior of the tubular support member; means for adjusting the size of the adjustable expansion device; and fluid powered means for pulling the adjustable expansion device through the expandable tubular member to radially expand and plastically deform the expandable tubular member; wherein at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation; and wherein at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation.

[00609] A method for radially expanding a tubular member has been described that includes positioning an expandable tubular member, an expandable tubular sleeve, and an adjustable expansion device within a preexisting structure; increasing the size of the adjustable expansion device to radially expand and plastically deform at least a portion of at least one of the expandable tubular member and the expandable tubular sleeve; and radially expanding and plastically deforming at least another portion of the expandable tubular member using the adjustable expansion device. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the method further includes pulling the adjustable expansion device through the expandable tubular member. In an exemplary embodiment, the method further includes pulling the adjustable expansion device through the expandable tubular member using fluid pressure.

[00610] A system for radially expanding a tubular member has been described that includes means for positioning an expandable tubular member, an expandable tubular sleeve, and an adjustable expansion device within a preexisting structure; means for increasing the size of the adjustable expansion device to radially expand and plastically deform at least a portion of at least one of the expandable tubular member and the

expandable tubular sleeve; and means for radially expanding and plastically deforming at least another portion of the expandable tubular member using the adjustable expansion device. In an exemplary embodiment, at least a portion of the expandable tubular member has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, at least a portion of the expandable tubular sleeve has a higher ductility and a lower yield point prior to the radial expansion and plastic deformation than after the radial expansion and plastic deformation. In an exemplary embodiment, the system further includes means for pulling the adjustable expansion device through the expandable tubular member. In an exemplary embodiment, the system further includes means for pulling the adjustable expansion device through the expandable tubular member using fluid pressure.

[00611] A method of increasing a collapse strength of a tubular member after a radial expansion and plastic deformation of the tubular member using an expansion device has been described that includes reducing a coefficient of friction between the tubular member and the expansion device during the radial expansion and plastic deformation of the tubular member; and reducing a ratio of a diameter of the tubular member to a wall thickness of the tubular member. In an exemplary embodiment, the coefficient of friction is less than 0.075. In an exemplary embodiment, the ratio of the diameter of the tubular member to a wall thickness of the tubular member is less than 21.6. In an exemplary embodiment, the collapse strength of a tubular member after the radial expansion and plastic deformation of the tubular member using an expansion device is greater than 5000 ksi.

[00612] A system for radially expanding and plastically deforming a tubular member has been described that includes a tubular member, and an expansion device positioned within the tubular member, wherein the coefficient of friction between the tubular member and the expansion device is less than 0.075, and wherein the ratio of the diameter of the tubular member to a wall thickness of the tubular member is less than 21.6.

[00613] A method of radially expanding and plastically deforming a tubular member using an expansion device has been described that includes quenching and tempering the tubular member; positioning the tubular member within a preexisting structure; and radially expanding and plastically deforming the tubular member. In an exemplary embodiment, the yield strength of the tubular member ranges from about 76.8 ksi to 88.8 ksi. In an exemplary embodiment, the ratio of the yield strength to the tensile strength of the tubular member ranges from about 0.82 to 0.86. In an exemplary embodiment, the longitudinal elongation of the tubular member prior to failure ranges from about 14.8% to 22.0%. In an exemplary embodiment, the width reduction of the tubular member prior to failure ranges from about 32% to 44.0%. In an exemplary embodiment, the width thickness reduction of the tubular member prior to failure ranges from about 41.0% to 45%. In an exemplary embodiment, the

anisotropy of the tubular member ranges from about 0.65 to 1.03. In an exemplary embodiment, the absorbed energy in the longitudinal direction of the tubular member ranges from about 125 to 145 ft-lbs. In an exemplary embodiment, the absorbed energy in the transverse direction of the tubular member ranges from about 59 to 59 ft-lbs. In an exemplary embodiment, the absorbed energy in a welded portion of the tubular member ranges from about 174 to 176 ft-lbs. In an exemplary embodiment, a flared expansion of an end of tubular member ranged from about 42 to 52%. In an exemplary embodiment, the tubular member comprises, by weight percentage: 0.27 C; 0.14 Si; 1.28 Mn; 0.009 P; 0.005 S; and 0.14 Cr. In an exemplary embodiment, the quenching of the tubular member is provided at about 970 C; and the tempering the tubular member is provided at about 670 C.

[00614] A radially expandable and plastically deformable tubular member has been described that includes a yield strength ranging from about 76.8 ksi to 88.8 ksi, a ratio of the yield strength to a tensile strength of the tubular member ranging from about 0.82 to 0.86, a longitudinal elongation of the tubular member prior to failure ranging from about 14.8% to 22.0%, a width reduction of the tubular member prior to failure ranging from about 32% to 44.0%, a width thickness reduction of the tubular member prior to failure ranges from about 41.0% to 45%, and an anisotropy of the tubular member ranges from about 0.65 to 1.03. In an exemplary embodiment, an absorbed energy in the longitudinal direction of the tubular member ranges from about 125 to 145 ft-lbs. In an exemplary embodiment, the absorbed energy in the transverse direction of the tubular member ranges from about 59 to 59 ft-lbs. In an exemplary embodiment, the absorbed energy in a welded portion of the tubular member ranges from about 174 to 176 ft-lbs. In an exemplary embodiment, a flared expansion of an end of tubular member ranged from about 42 to 52%. In an exemplary embodiment, the tubular member comprises, by weight percentage: 0.27 C; 0.14 Si; 1.28 Mn; 0.009 P; 0.005 S; and 0.14 Cr.

[00615] A radially expandable and plastically deformable tubular member has been described that includes: a yield strength ranging from about 40.0 ksi to 100.0 ksi; a ratio of the yield strength to a tensile strength of the tubular member ranging from about 0.40 to 0.85; a longitudinal elongation of the tubular member prior to failure ranging from at least about 22.0 to 35.0%; a width reduction of the tubular member prior to failure ranging from at least about 30.0% to 45.0%; a width thickness reduction of the tubular member prior to failure ranges from at least about 30.0% to 45.0%; and an anisotropy of the tubular member ranges from at least about 0.65 to 1.50. In an exemplary embodiment, an absorbed energy in the longitudinal direction of the tubular member is at least about 80 ft-lbs. In an exemplary embodiment, the absorbed energy in the transverse direction of the tubular member is at least about 60 ft-lbs. In an exemplary embodiment, the absorbed energy in a welded portion

of the tubular member is at least about 60 ft-lbs. In an exemplary embodiment, a flared expansion of an end of tubular member ranges from at least about 45 to 75%.

[00616] A method of manufacturing a tubular member has been described that includes fabricating a tubular member; positioning the tubular member within a preexisting structure; radially expanding and plastically deforming the tubular member within the preexisting structure; and baking the tubular member within the preexisting structure. In an exemplary embodiment, the preexisting structure comprises a wellbore. In an exemplary embodiment, the fabricated tubular member comprises a dual phase steel pipe. In an exemplary embodiment, the fabricated tubular member comprises a microstructure comprising about 15 to 30% martensite; and ferrite. In an exemplary embodiment, the fabricated tubular member comprises, by weight percentage: 0.1 C; 1.2 Mn; and 0.3 Si. In an exemplary embodiment, the fabricated tubular member comprises a TRIP steel pipe. In an exemplary embodiment, fabricating the tubular member comprises: cold rolling the tubular member; and inter critical annealing the tubular member. In an exemplary embodiment, the fabricated tubular member comprises a dual phase steel pipe. In an exemplary embodiment, prior to the cold rolling, the fabricated tubular member comprises a microstructure comprising ferrite and pearlite. In an exemplary embodiment, the inter critical annealing is performed at about 750 C. In an exemplary embodiment, after the inter critical annealing, the fabricated tubular member comprises a microstructure comprising ferrite and at least one of pearlite and austentite. In an exemplary embodiment, the method further comprising: cooling the tubular member after the inter critical annealing. In an exemplary embodiment, after the cooling, the tubular member comprises a microstructure comprising martensite. In an exemplary embodiment, the baking is provided at about 100 C to 250 C. In an exemplary embodiment, following at least a portion of the baking, the tubular member comprises a bake-hardened portion. In an exemplary embodiment, following at least a portion of the baking, the tubular member comprises a stress-relieved portion. In an exemplary embodiment, following at least a portion of the baking, the tubular member comprises a bake-hardened portion and a stress-relieved portion. In an exemplary embodiment, the cold rolling comprises: allowing the tubular member to cool over time from a first temperature to a second temperature along a temperature versus time curve; and at a plurality of stages along the curve, deforming the tubular member. In an exemplary embodiment, at a first stage along the curve, insoluble precipitates within the tubular member retard austentite growth. In an exemplary embodiment, at a first stage along the curve, deformation of the tubular member promotes precipitation. In an exemplary embodiment, at a second stage along the curve, insoluble precipitates within the tubular member inhibit recrystallization. In an exemplary embodiment, at a second stage along the curve, austentite grains are conditioned.

[00617] It is understood that variations may be made in the foregoing without departing from the scope of the invention. For example, the teachings of the present illustrative embodiments may be used to provide a wellbore casing, a pipeline, or a structural support. Furthermore, the elements and teachings of the various illustrative embodiments may be combined in whole or in part in some or all of the illustrative embodiments. In addition, one or more of the elements and teachings of the various illustrative embodiments may be omitted, at least in part, and/or combined, at least in part, with one or more of the other elements and teachings of the various illustrative embodiments.

[00618] Although illustrative embodiments of the invention have been shown and described, a wide range of modification, changes and substitution is contemplated in the foregoing disclosure. In some instances, some features of the present invention may be employed without a corresponding use of the other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.